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ABSTRACT

This description of the Model Edspec, which can be used by itself or in conjunction with the "Format Guide of Educational Specifications," serves as a comprehensive planning tool for the selection and application of technology. The model is designed to assist schools in implementing the facilities development process, thereby making electronic learning a reality in each and every school; to serve as a primer for incorporating electronic technology into the educational plan of a specific school; and to stimulate exploration beyond the current limits of technology. Based on 12 belief statements, the model is not intended to be prescriptive or restrictive, but to provoke thoughtful consideration of the school's requirements. The first section of the document describes electronic communications systems, including voice systems, video systems, data systems, and electronic networks. Building components, including structural, electrical, lighting, climate control, fire/life safety, security, and acoustics are addressed in the next section; and the third section discusses activity areas, including administration, food service, guidance, health, instruction, and the library media center. Three appendixes present electronic communications systems planning criteria; a technical overview of local area networks; and functional and space requirements. (ALF)

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MODEL EDUCATIONAL SPECIFICATIONS FOR TECHNOLOGY IN SCHOOLS

MARYLAND STATE DEPARTMENT OF EDUCATION
OFFICE OF ADMINISTRATION AND FINANCE - SCHOOL FACILITIES OFFICE

200 WEST BALTIMORE STREET
BALTIMORE, MARYLAND 21201

MARCH 1991

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FOREWORD

When we step back and look around America today, we see a nation where the use of information and communications technologies has radically changed commerce and business, as well as our scientific and financial institutions. Our business people and scientists live in an "information age" in which "knowledge" workers practice their professions knowing that they belong to a wired nation and a global village. We have only to walk downtown in any vibrant American city to see to what an astounding degree and speed business has responded in shaping its physical working environment in response to those technologies.

Looking further into the big picture, we need to see the America of education in a similar 21st century context. But now we see a different nation. We see schools that still reflect their 19th century roots and educators who cling to beliefs that knowledge should be concentrated in each neighborhood in an island known as "the school". Our public school buildings and classrooms are from the past, some of their original construction built seventy or more years ago. Much of the renovation and new design is based on the modern school concept dating back to the post-World War II era 45 years ago. Similarly, technologies in most of America's schools have not kept pace with those used in the larger society. For example, telephones and videotapes, computers and optical data storage, simulations and satellites have scarcely affected the operations of schools, while they have transformed the operations of most businesses.

Unaware that the power of newer technologies can never be fully realized by small-scale action and piecemeal upgrading, schools have tended to add electronic technologies in only small ways. Using these small-scale applications they are satisfied with the notion that they are into "educational technology." Only full-scale applications can make schoolwork more interesting, teachers more capable and students more engaged, and--not to be overlooked--schools managed more efficiently. Restricting the interest in technology to the uses of technology "in the classroom" is as if we believe that our institutional forms are God-given and that technology must be appended to them or shoehorned into them.

American education wants to remain competitive, and it needs the buildings to support, not handicap, that effort. Our investment in schools must be rid of obsolescence, all buildings in which "school" takes place must become good places to be. We have at hand the power to bring about a technological revolution and erect electronic schools across our nation, designing our facilities to fit and serve that revolution. Where we need labs and classrooms let us bring the information age into them, not as an alien but as a friend. Let us begin to shape our buildings for the most powerful educational force since chalk: electronic learning.

Under the umbrella called "Schools for Success" Maryland has launched its School Performance Program whose goals and strategies, by inference, embrace electronic learning. The Model Educational Specifications for Technology in Schools is designed to assist schools to implement the facilities development process, thereby making "Success for Schools" a reality also in the bricks-and-mortar of each and every school.

JAMES A. MECKLENBURGER

Dr. Mecklenburger is director of the Institute for the Transfer of Technology to Education, National School Boards Association.

PREFACE

Electronic technology is part of everyone's life today. School systems all over Maryland recognize this and respond by introducing computers to classrooms. administrative technology to offices; some school systems even link classes in several schools by the use of interactive television.

Learning as they went, school staffs created information-age facilities, carving them out of whatever available space they could find. The results were often innovative and successful enough to earn national recognition. But school systems do not always have the resources to equip their schools with the technology best suited for the students. Furthermore, linking appropriate technology and instructional methods with an existing or planned facility often remains a vexing problem. The computer is becoming as common as the blackboard in our classrooms, but most schools have yet to use it more inventively than they use the blackboard.

The level of technological complexity today begs for improved school management, instruction, and staffing changes. It now takes a full-time staff person to support and assist with the uses of technology as a tool for instruction and administration. At the very minimum, staff support and assistance should be available on an on-call basis at the local school system level. Electronic learning has put the classroom in the realm of technology.

Regardless of how the future is viewed, it must be recognized that school buildings represent sizeable investments of our community resources. Accelerated societal change may call for the replacement of a functionally obsolete resource, but the realistic likelihood is that this will be perceived as the squandering of a resource. Therefore, better patch and modernize and make it last the full brick-and-mortar lifecycle of some fifty years.

Because the school's future will be altered for better or worse by decisions made today, reuse strategies must include evaluating an existing building's ability to support new and emerging technologies with sufficient flexibility. The end product must not be a building that exists in a perpetual state of resistance to the new, but one that has been rejuvenated to adapt itself to come-what-may change. The choice rests with those who are charged with planning for the future.

It was in response to the above that the Technology in Maryland Schools (TIMS) committee was formed to address the following goal:

> **ALL MARYLAND PUBLIC SCHOOL FACILITIES SHALL BE DESIGNED, BUILT, AND RENOVATED TO ACCOMMODATE TECHNOLOGY-AIDED INSTRUCTION AND ADMINISTRATION.**

In support of the above goal, the TIMS Committee developed the following mission:

> **TO GAIN SUPPORT OF SCHOOL ADMINISTRATORS AND TEACHERS FOR AN ARCHITECTURE BY WHICH EVERY SCHOOL FACILITY WILL FUNCTION AS A DYNAMIC, TECHNOLOGY - EMBRACING LEARNING ENVIRONMENT.**

The task was to produce a clear and usable model for a set of educational specifications that would be the foundation for a dynamic learning environment embracing technology. The model should identify the essentials that comprise both the educational delivery system and the physical learning environment. The TIMS Committee formulated from those essentials the set of beliefs incorporated in this model.

The Maryland State Department of Education, Office of Administration and Finance, School Facilities Office, in conjunction with the Division of Instruction and supported by the Division of Instructional Technology and the Division of Library Services, is pleased to present the TIMS Committee's work. The present and past members of the committee are:

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Kathryn Alvestad	Vice Principal, Huntingtown Elementary School Calvert County Public Schools
Gail Bailey	Division of Library Development Services Maryland State Department of Education

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MODEL EDUCATIONAL SPECIFICATIONS FOR TECHNOLOGY IN SCHOOLS

MODEL EDUCATIONAL SPECIFICATIONS FOR TECHNOLOGY IN SCHOOLS

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INTRODUCTION

While this Model Edspec serves as a comprehensive planning tool for the selection and application of technology and can therefore be used by itself, it is best used as a companion to the Format Guide for Educational Specifications[1]. The Format Guide provides writers with a suggested format and framework for educational specifications.

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[1] A publication from the School Facilities Office, Maryland State Department of Education.

The Model serves as a primer for incorporating electronic technology into the educational plan of a specific school--existing or new. As a vital part of the edspec development process, facilities planners must see themselves as proactive participants in restructuring learning and, subsequently, the learning environment. Planners, curriculum personnel, and principals together need to lend their respective skills and expertise to the process. School board members should find in the Model enlightenment and a resource. A facility that is the home to a successful blend of curriculum and technology then becomes an attainable goal.

All educational facilities convey subtle messages. They can either aid or inhibit performance, or they can influence programs and the way they are offered. The intended users of the Model should understand this and should, therefore, have a heightened concern for quality education in a quality building. They must think through the impact of user needs and instructional methods several years beyond opening or reopening day. As a resource and a source of information on the power of technology, the Model should stimulate and encourage exploration beyond the current limits of technology.

To satisfy the technology demands of its occupants, buildings must reflect a level of capitalization in line with those demands. To protect this investment suggests improved maintenance and operations programs. An electronic school-based management program linked to a local education agency (LEA) asset management program would be an appropriate goal.

TABLE OF CONTENTS

Foreword . . . . p. i
Preface . . . . p. iii
Acknowledgements . . . . p. vi

Introduction . . . . p. 1
Belief Statements . . . . p. 5
The Design Process . . . . p. 6

Section I ELECTRONIC COMMUNICATIONS SYSTEMS p. 7

Voice Systems . . . . p. 8
Video Systems . . . . p. 10
    Distribution Systems
    Technical Notes
Data Systems . . . . p. 14
Electronic Networks . . . . p. 15
    The Facilities Network
    Local Area Networks
    Integrated Services Digital Network
    Technical Overview of LANs
    Considerations

Section II BUILDING COMPONENTS . . . . p. 20

Life Cycles . . . . p. 20
Structural . . . . p. 21
Electrical Power . . . . p. 23
Lighting . . . . p. 26
Climate Control . . . . p. 28
Fire/Life Safety Systems . . . . p. 29
Security Systems . . . . p. 30
Acoustics . . . . p. 32
Building Support . . . . p. 33
Finishes . . . . p. 36
Acceptance Testing of Systems . . . . p. 37

Section III ACTIVITY AREAS . . . . p. 38

- Administration . . . . p. 40
- Building Support . . . . p. 42
- Food Service . . . . p. 42
- Guidance . . . . p. 43
- Health . . . . p. 44
- Instruction . . . . p. 45
  - The Generic Classroom . . . . p. 47
  - Career and Technology Education . . . . . p. 49
  - Art . . . . p. 54
  - Music . . . . p. 54
  - Physical Education . . . . p. 55
  - Science . . . . p. 56
- The Library Media Center . . . . p. 59
- Instructional Support . . . . p. 61
  - Computer Clusters . . . . p. 61
  - The Computer Lab . . . . p. 61
  - The Interactive TV Classroom . . . . p. 64
  - A TV Production Facility . . . . p. 68

Appendix A ELECTRONIC COMMUNICATIONS SYSTEMS PLANNING CRITERIA . . p. 70

Appendix B LOCAL AREA NETWORKS TECHNICAL OVERVIEW . . . . p. 72

Appendix C FUNCTIONAL and SPACE REQUIREMENTS . . . . p. 80

The Model Educational Specifications for Technology in Schools affects each one of the sections in the Format for Educational Specifications.

BELIEF STATEMENTS

The following beliefs should guide all those charged with or otherwise involved in the execution of educational specifications.

- The Educational Delivery System must be responsive to the demands of a technological, information-based society.
- The Educational Delivery System is more effective when the learner is actively involved in the teaching/learning process.
- The Educational Delivery System must include physical environments that effectively utilize changing technologies.

Following the above beliefs, the full but judicious use of electronic technology must become a given. Hence, the following beliefs regarding the physical learning environment must hold:

- Every school facility will contribute constructively to its occupants' educational, physical, and emotional needs and sense of well-being when physically designed to do so.
- Every school facility will serve as a teaching tool when physically designed to do so.
- Learners should be stimulated and motivated to learn by the school facilities they inhabit throughout their years of schooling.
- Every school facility is a community resource. As such, it both serves and takes advantage of the community's human and technological resources.
- Judicious use of advanced communications systems enhances school administration and student support.
- Judicious use of advanced building engineering systems enhances facilities operations and maintenance.
- A technologically advanced learning/teaching environment enhances the development of all levels of learners and frees teachers from many administrative and repetitive activities.

- Linkage with other learning environments, domestic or foreign, private or public, is beneficial to the learner and the teacher.

- School facility design must avoid being state-of-the-art specific. It must be capable of adjusting to future technological demands.

Educational facilities convey subtle messages, they aid or inhibit performance or they influence programs and the way they are offered.

THE DESIGN PROCESS

At the heart of the architectural design process is the functional interpretation of program requirements. As such, nothing in the Model is intended to be prescriptive or restrictive. It should provoke thoughtful consideration of the school's requirements and encourage innovation and vision.

Suggested subheadings within each activity area are outlined in Section III of the Format Guide. They contain the necessary technical information required for a complete and functioning activity area.

Providers of packaged systems may desire specific input and are prepared to make recommendations on system designs. In the early stages of edspecs development school planners may wish to avail themselves of such services. It is a way to learn what choices the market currently offers, provided that commitments for use are avoided. Actual system design choices should be made on the recommendations from consultants and architects engaged by the LEA.

School facilities provide a critical contribution to teaching and learning. School systems can begin to maximize facilities life cycles when it is recognized that functional life cycles are not solely dependent on the materials with which buildings are built but on the manner which they are designed to incorporate technology. A school constructed ten years ago without much attention to technology may therefore be not much different from one 60 years old. The goal must be to accommodate state-of-the-art technologies and to provide capacities and ready access for future technologies without being burdened by costly, major renovations.

SECTION I – ELECTRONIC COMMUNICATIONS SYSTEMS

The electronic communications systems of a school belong to the family of telecommunications that is, as Webster defines it, the science of communicating at a distance. In today's school facilities this means the transmission of voice, video, and data within the school, among school buildings, to the outside world, even outer space.

Telecommunications in the form of integrated facilities and district-wide network capability must be an integral part of the basic design of every school building. The need for integration of various networks has been thrust upon us by dramatic changes in telecommunications.

The following basic electronic systems are necessary for comprehensive telecommunications for a school:

VOICE: The accessibility of two-way voice communication and messaging (telephones) between staff members in the building and the school community. The voice system should incorporate a public address system.

VIDEO: The accessibility of television communication and all forms of video transmission, including audio, from locations within the school building as well as from the outside.

DATA: The interconnection of equipment throughout the school (Local Area Network), plus two-way access (Wide Area Network) to outside resources such as computers in the central office, in other schools, home computers, bulletin boards, and databases.

It is beyond the scope of this document to alert the user to the many new and emerging communication technologies. School facility planners may nevertheless want to assess on their own the potential of some, infra-red technology, for example, in technology applications 10 - 15 years hence.

PURPOSE

Schools can best capitalize on the vast array of educational resources available through modern communications technology by carefully addressing functions, capacity, compatibility and costs during the planning stage.

The electronic technology potential of the school building should inspire teachers and administrators engaged in planning to think differently and creatively about instructional options available to them.

Educational specifications should be prepared for all discrete activity areas of a school. Electronic communications systems are expected to serve as an intelligent support system, enhancing instruction for learners. If the integrated learning systems chosen for the instructional programs are to be realized, edspecs must be considered to be an essential part of that realization.

To reach this realization, a number of specific planning criteria should be applied at the onset of the educational specifications planning process. These criteria are included in Appendix A of this document. They should be studied and integrated into the planning process.

VOICE SYSTEMS

Precursors of electronic voice systems can be found in many of our schools today. We know them as communications tools such as the telephone and the public address system. Telephones link administrative offices with each other and with telephone networks beyond the school. Teleconferencing is commonly used and requires long distance capability. Student-use and long-distance dialing is currently often limited to coin-operated "public phones", and PA systems limited to paging and announcements within the school.

Engineering developments have blurred the boundaries between discrete voice communications tools. Telephone lines have evolved into twisted pair wiring carrying more than voice, and fiber optics has the capacity to carry both voice and data.

Systems integration, now well under way, continues to increase. It becomes important, therefore, that a similar mental integration take place in the minds of those planning new and upgraded facilities. Voice communication must be seen as an aid to instruction, capable of conveying many levels of information. It belongs in every classroom. A brief description of three systems found in schools follows.

TELEPHONE: Used for point-to-point communications and teleconferencing. Calls are usually administrative in nature, but instructional support services are on the increase. Voice communications link teachers in all instructional areas. The security aspect of this must not be overlooked. Telephones can provide the sound of classroom activities to students who are home-bound, unable to attend class. Students can ask questions, listen to discussions and receive instruction.

TWO-WAY RADIO: Used in schools as an administrative communications service for system-wide applications. Designed to supplement the telephone system, radio transmitters can be used to send emergency messages to schools from a central location or from mobile buses, cars, or service vehicles.

PUBLIC ADDRESS: PA systems are best integrated with the telephone system, to be used to provide direct voice communication via handsets or speakers with classrooms. Messages can be sent to select classrooms or to all, simultaneously. Other features may include voice contact from classrooms to various rooms in the school.

PA systems are "hard-wired" microphone/amplifier units with speakers located in locations throughout the school facility.

When planning a complete voice system, check the boxes of the following list after specific action has been taken on each item.

☐ Provide enough outgoing lines and telephones to serve all staff members and school offices with a minimum of disruption and delay.

☐ Provide enough incoming lines to meet community and administrative needs. Estimate the call volume; if it exceeds the handling capacity of the reception area, provide a direct-dial system.

☐ Provide adequate telephone lines for the remote transmission of hard copy, such as from fax machines.

☐ Where applicable, provide teletypewriter (TTY) services for the deaf. To accommodate hard of hearing and/or physically handicapped individuals, provide modifications that include pay phones accessible to wheelchair-bound individuals.

☐ Have available receivers with voice amplification.

☐ Provide sufficient capacity in the telephone system to allow for such developing technologies as voice processing and voice mail, and access to computer bulletin boards and databases.

☐ Provide a public address system that can be heard in all necessary locations with originating capabilities in appropriate locations.

VIDEO SYSTEMS

Until recently, a video system meant capturing signals with a roof antenna and sending them over cables to selected teaching locations. A tap in the wall, some amplifiers, and a few television sets on carts were all that was needed.

Today video systems include a variety of program sources coming to the school via over-the-air broadcasts, by microwave, satellite, and or cable. Videotapes are produced on site and fed to remote teaching locations. Videodisks and a two-way interactive TV are rapidly becoming standard instructional fare.

DISTRIBUTION SYSTEMS

TV distribution systems provide an effective means of delivering video-based information. Utilizing cable networks, television equipment can serve both instructional and administrative areas of a school facility. The main part of the distribution system is referred to as the "head-end" where distribution equipment and cabling originate.

Program sources for distribution systems are:

MATV: Master antenna television. MATV signals are received through rooftop or rabbit ear antennas. MATV systems are becoming integrated with data transmission.

CCTV: Closed circuit television. Signals are provided by video cameras, VCRs or character generators. This system can be used both for teleconferencing and surveillance. Independent telecommunication cable networks, not owned by a commercial cable company, provide feasible links between schools.

CATV: Cable television. CATV signals are provided by the local cable TV franchise in the area. Certain reception (demodulation) equipment is required. If TV sets are cable-ready, no cable company converter boxes are necessary.

SATELLITE: This is a downlink in the form of a satellite dish that is capable of receiving signals from distant sources and relayed via satellites.

MICROWAVE: Microwave signals are usually received on a line-of-sight basis from a source no more than 25 miles away. A small roof-mounted microwave dish receives the signals.

When planning a complete video system, check the boxes of the following list after specific action has been taken on each item.

☐ Provide the capability to receive programming originated by the school system (if any) as well as commercial and public television stations, whether through a master antenna or via cable, microwave or satellite. The signals should be receivable at teaching stations and learning stations throughout the building.

☐ Provide the capability to broadcast instructional programs and other presentations from one part of the school to others.

☐ Provide the capability to share instructional programs and other presentations with classrooms in other schools.

☐ Provide the capability in classrooms to dial library media center (LMC)-based VCRs for pre-arranged program viewing on command.

☐ Provide the capability to conduct two-way interactive classes and staff training activities among several schools.

☐ Provide the capability to link television with computers, VCRs, and videodisk players to take advantage of interactive video teaching programs, desktop publishing, etc.

Television production instruction is part of a unified media program. A formal television studio is warranted in a school that has such a curriculum in place. Here TV programs can be produced by students as part of the instructional program. These can include current events within social studies, drama, journalism, student tutorial programs, etc. Where the need for a studio has been established, a staff person must be assigned to be responsible for scheduling its use and for its equipment. Portable TV production equipment, suitable for outside and most classroom use, is recommended for all other situations.

For a more detailed description of a TV production facility, refer to Section III -- Activity Areas, Instructional Support.

TECHNICAL NOTES

A system VHF/UHF antenna should be located on site prior to design for the most powerful signal. Anticipate fiber optic cable by providing appropriately sized and protected metal (for grounding) conduit running with the coaxial cable. Video networks require larger conduits than twisted pair; multi-cable conduits are not less than 2". Provide shielding from the source to the head-end.

Components of any distribution system include amplifiers, modulators, switchers, routing units, wall taps, attenuators, demodulators, converters, etc., interconnected to provide a picture source (television signal) to any number of activity areas. Many of the components are interconnected and housed in a central location, called a "head-end." The recommended location for the "head-end" is the library media center, reflecting its function as a processor and distributor of electronic media. The purpose of the head-end is to strengthen and allocate the television signal to the proper location. It is usually mounted in a metal panel or equipment rack with several coaxial cables leading from it to various locations.

Coaxial cables should be integrated into other power distribution and data communications systems. Where cables and wires must run together, consider using fiberoptic cables as a precaution against crossover interference. At the room locations, the coaxial cables are brought to a wall tap or TV connector that provides reception to the TV receiver located in the room. Every school should have the capability to provide multiple signals to various locations from a single program source.

This capability permits sharing pre-taped programs with many classrooms, messages from the principal can be delivered to the entire student body simultaneously, etc.

The basic configurations of TV distribution systems are "home-run" and loop systems. A home-run system consists of individual cables to specific areas from the head-end. It provides "addressable" distribution of the TV program; that means that any room can be selected for viewing. It is better but costlier, requiring more cable, larger conduit, and sophisticated routing equipment. The system can also be configured to provide local origination, that is, the ability of the classroom location to send signals to the head-end or switch for distribution to other classrooms. It is a flexible and useful design for school systems.

The less expensive "loop" system is a configuration that connects classrooms in a daisy chain fashion. This configuration is used where there is a large number of room locations. It minimizes the amount of cable required. However, the loop system is not addressable without specialized electronics at each classroom, system problems are difficult to locate, and failure at one location causes loss of signal to all "downstream" locations.

Common twisted pair, cable systems and fiberoptic systems allow transmission of signals in two directions. Although cable diameters are small due thinness of the glass fibers, fiberoptic cables require larger conduits and sleeves through the building structure. Also, the permissible radius of a bend in fiberoptic cable is limited to the optics of the fiber. Too sharp a bend causes light leaks from the side of the fiber.

The cost of a two-way fiberoptic system, including various necessary components, is competitive with comparable twisted pair or coaxial cable systems designed for similar performance. The decision which system, or mix of systems, to use in a specific school must be based on the planned instructional methods and, to a lesser extent, on the building configuration already in place or being planned.

Please refer also to tables I & II, Comparisons of transmission media, in Appendix B.

DATA SYSTEMS

Administrative Data Systems are designed for the collection, analysis, and distribution of school data. These systems provide a tool for recording attendance and scheduling and for administrative purposes such as payroll and accounting. They are used for electronic mail and for maintenance and operations programs.

Instructional Data Systems are used for software updates, accessing remote information sources, and accessing Library Media Center resources from outside the school. These systems lend themselves also for electronic mail and computer-mediated conferencing.

> TELECOMMUNICATIONS: A term used to describe electronic communications generally using telephone lines as the means by which devices are connected. In most cases such communication occurs between computers. Computers can communicate with each other over telephones by means of a modem. Electronic banking, on-line database services, and the use of computer bulletin boards are examples of the capability of telecommunication systems.
>
> ELECTRONIC MAIL: The process of sending and receiving written messages through a particular communication network either internally to the facility (local area network) or externally (telecommunications).
>
> E-mail is electronically transmitted over phone lines from a single sender to one or more recipients who can easily reply. Since E-mail is a digital file, it can be manipulated, edited, saved, and retrieved like any other word-processor file. A significant use of E-mail is on bulletin board services (BBS). A few non-commercial computer networks that are collections of linked individual networks are also available. These allow anyone, using one of the member networks, to communicate with people on any other member network.
>
> HYPERMEDIA: A computer-based system, also referred to as interactive multimedia, that combines a variety of technologies in a unified information-delivery system. Hypermedia incorporates video, sound, text, graphics, and computer images whose selection is controlled and directed by the user. The user navigates through the multimedia information base using intuition, memory, and interest as a guide. Hypermedia is used in the classroom as a reference tool for teachers and students, both individually and in groups. It can also serve as a presentation tool for demonstrations and reports. Computers have the ability to "capture" images from video tape, slides and printed pictures; the images are stored digitally in the computer, to be used when

needed. The computer can also direct videodisk and CD-ROM players to select areas of the program in accordance with the user's needs.

COMPUTER-MEDIATED CONFERENCING: A computer-based environment for groups of individuals who want to maintain a discussion or problem-solving session over extended time periods.

DESKTOP PUBLISHING: A term describing an activity that uses a computer with a printer and publishing software to create custom graphics and text used for publishing newspapers, brochures, reports, correspondence, and books.

When planning a complete data system, check the boxes by the list on the next page after specific action has been taken on each item.

☐ Provide the capability to enable instructional computers to communicate with similar devices within the school and to access other internal networks.

☐ Provide a computer network within the school building compatible with those in other school buildings and the central office. This permits immediate and complete sharing of data.

☐ Provide a data communication network capable of monitoring building controls, including emergency controls, services and security.

☐ Provide computer capability to deal with user-to-user communications (school-to-school; school-to-central administration; other).

ELECTRONIC NETWORKS

THE FACILITIES NETWORK

The facilities network of a school is the aggregate of its transmission systems, switching systems and station equipment; it facilitates the movement of electronic information within the school. Examples of these systems are as follows:

TRANSMISSION SYSTEMS: Multipair copper cable (i.e. twisted pair), Coaxial cable, Fiber optic cable.

SWITCHING SYSTEMS: Connect appropriate lines to form a desired path between two locations.

TERMINAL EQUIPMENT: Any device capable of sending or receiving electronic information.

TRAFFIC NETWORKS: Voice, Video, Data

Whenever possible, every planning committee should include local technical experts who are associated to some degree with the school. The task of the committee is to explore the communications potential and the goals for the school before any facilities network is designed. The object is to assure that the network will be usable and affordable.

Network design, which is best left to specialist engineers, involves the careful selection of various circuit parameters and/or the selection and interconnection of various devices.

A well-managed network means establishing and maintaining operational procedures that will keep the network operating near maximum efficiency. Such procedures should be established under the guidance of the engineer who designs the network.

The objective is to plan and design an integrated facilities network that strikes a satisfactory balance between the accurate, timely, and secure delivery of user data and final cost. To accomplish this, factors other than the costs of terminals and networks must be considered. For example, installing a local area network is considered cost-effective because of lower software costs. In other situations, reliability is the basic cost justification. If price were no object, most networks would be simple point-to-point channels. Indeed, if a point-to-point channel can be kept busy at a reasonably high rate, then it may be the most cost-effective way to handle a particular communications task.

However, an insufficient volume or low demand for data may not justify the cost of dedicated channels. In such cases it may be advisable to combine calls from more than one source into a single transmission path by means of multiplexers and other networking devices.

LOCAL AREA NETWORKS

Local Area Networks (LANs) are useful instructional aids as well as administrative tools in schools.

School-wide LANs give teachers access to all available software. A LAN stores large amounts of information and data that can be readily accessed as needed from a number of locations in the school. Floppy disks are fragile repositories of data. The network eliminates constant handling of disks by teachers and students, thereby avoiding the loss of valuable information.

A LAN with management features allows teachers to diagnose, prescribe, and assess student work more efficiently.

Certain software packages and networks allow students to "conference" with each other and the teacher via the computer screen. This activity can help develop communication skills.

LANs can be installed and utilized in a variety of configurations within a school building. Arrangements are suited for single activity areas, the cluster, and multiple activity area configurations. Each setting provides advantages and disadvantages for both installation and the instructional process, as follows:

> SINGLE ACTIVITY AREA: In this configuration, the file-server, the teacher workstation and the single student workstation are networked. The LAN provides individualized or small group access and permits easy modification of activity area or classroom seating arrangements.
>
> CLUSTER: Here small groups or "clusters" of networked workstations are placed in various activity areas around the school. This provides access to the system from more locations and provides for specialized class activities.
>
> MULTIPLE ACTIVITY AREA: In this arrangement a single workstation or a small number of workstations (networked) are set up in individual activity areas. This provides for teacher-focused demonstration and limited individual access.

INTEGRATED SERVICES DIGITAL NETWORK (ISDN)

The Integrated Services Digital Network (ISDN) is the basis for a future universal network, provided by the local telephone company. It will support almost any type of communications device or service. ISDN is an intelligent, switched digital network capable of transmitting voice, video, and data simultaneously over existing telephone wires.

The development of ISDN will result in a new communications network that provides users with services not possible in the past. With ISDN, users can transmit and receive both data and voice on the same line at the same time; two separate lines and a modem are not required. The potential benefits for local school systems lie in the effortless linking of schools and administrative offices with each other. Students in special situations, such as the homebound, can be easily linked with their school.

ISDN combines the coverage supplied by the familiar telephone network with the data-carrying capacity of digital data networks. Several public voice networks are already becoming digital, so ISDN is well-suited to meet the growing needs of data users in schools.

TECHNICAL OVERVIEW OF LANs

Several different LAN designs are available from a variety of vendors. They vary in four broad areas: Software Access, Topology, Cabling and Transmission Techniques. Each LAN design has associated benefits, based upon the needs of the facility and the end-users. System requirements will provide the basis for selecting the most appropriate LAN design. A description of the four areas noted above is provided in Appendix B -- Local Area Networks Technical Overview, page 71.

CONSIDERATIONS

The many computer network vendors in the marketplace offer a great number of networking products. With so many systems available to choose from, schools need to identify specific needs and requirements, based on the activities and the instructional program. The performance of a system must be based on a number of criteria, several are included below. Place an appropriate mark in the box whenever a specific action has been taken on that item.

☐ Establish the number of workstations, including any peripheral equipment to be networked. Allow for future growth, expansion and modification. Determining factors include the desired distribution of a particular software, the desired number of students per computer, the offices or teaching stations that must be linked, etc.

☐ Define those resources that teachers, students and staff need to share (software, printers, modems, electronic mail, etc.).

☐ Establish the volume of data that the network system must support. Estimate the total number of users on the network.

☐ Define the maximum distance between workstations for optimal performance.

☐ Determine the instructional needs of each teacher.

☐ Establish the physical and learning characteristics of the learners.

The specialist engineer is responsible for resolving the above factors in the form of architectural solutions. However, the developers of educational specifications should have a basic understanding of the advantages and disadvantages of networking when comparing networking to stand-alone computers. Advantages include: reduced cost through site licensing of software and shared resources; functionality (the ease of use of a network and materials, effective record keeping, centralized resources); networking replicates the commercial world. Disadvantages include: initial increased cost; initial increased planning time; need for trained coordinators; and potentially higher maintenance expenses.

SECTION II – BUILDING COMPONENTS

LIFE CYCLES

The life of a school building is often thought to be synonymous with its structural life that may reach fifty years or more. However, the components of a school building do not age at the same rate.

Electronic technology may accelerate instructional and administrative demands and school usage. This, together with ergonomics and heightened comfort standards, will bring about remodeling needs before the age limits of most components are reached. Since there are no universally accepted standards for life cycles of building components in schools, the following may serve as an indication of how long a component can be expected to remain in place before it is moved modified or altered in some way.

Information systems - work stations, switching and control systems	2 - 12 years
Interior settings (occupant settings, room dividers, furniture arrangements)	1 - 9 years
Building interiors (partitions, ceilings, lighting, furniture, wall and floor coverings)	8 - 15 years
Building infrastructure (HVAC, elevators, wiring, plumbing, roofing)	10 - 25 years
Building structure, including external skins (walls, windows), core, parts not changed	50 + years

The building components used in this document are listed on the next page. Facilities planning must take particular account of installation requirements for electronic technology in each building component, particularly in existing buildings.

Structural (i.e., under floor installations; beefed-up joists)
Electrical power - general and special requirements
Lighting (i.e., glare-free light; task lighting)
Climate control
Acoustics
Building support (i.e., various HVAC and telecommunications systems)
Finishes (i.e., carpet squares for floor cable)

Before the completion of installation, procedures for systems testing must be in place. Facilities planning involves also procedures for care, service, and maintenance planning and choosing service contracts. The cost of these may influence one's choice of vendors.

The significant capital investment in various life cycles should heighten awareness for the critical importance of quality maintenance and operations programs. Not only is preventive maintenance essential for reducing lifetime costs, it is essential for reaching the life expectancies in the first place.

STRUCTURAL

The application of electronic technology affects layout, space configuration, location of utilities, and structural and mechanical designs throughout the school. While present technologies may be known, future ones are not. Therefore, it is of utmost importance that the building--beginning with the structural elements--be designed in anticipation of deferred and future needs as well as the unknown demands of future generations of electronic technology. Structural systems must allow expansion outward and, in case of limited sites, upward, not just between classrooms.

The economics of construction favor limiting above-ceiling space. When ceiling systems attach to the underside of structural elements, such elements should be of a truss or open web design where steel is the structural material. Structural concrete elements must be designed with sleeves of ample size to accommodate cables and wires. Whether they are distributed on trays or singly, the sleeves must be designed to accomodate all possibilities.

Concrete floor slabs on grade must also be designed to accommodate cables and wires. A raised floor or cellular floor system is not generally competitive in price with slab-on-grade. One may be advisable only in rare cases where a mainframe and various peripherals are linked throughout a sophisticated building and the need for change is infrequent. Raised floor areas should be kept at a minimum.

A more economical solution is a trough in the floor slab. A trough in the shape of an H or U or a rectangular depressed floor area, centered in the floor of an activity area, allows direct connections to computers located anywhere in the space. For smaller spaces, such as offices or resource rooms, a simple letter I configuration should suffice. Raised floor panels for depressed areas may be costly, but the resulting flexibility makes them cost effective. Metal trough covers tend to be ugly unless covered with carpet. Please refer to page 75 in Appendix B for an illustration of one approach.

Cable and wire conduits for voice, video, and data systems are best provided at this stage. Provide also wire closets for their interconnection. It must be emphasized that no signal wires must be placed in the same conduit with power wires.

We have grown accustomed to utility poles, used because often no other economical solutions can be found in existing buildings. They consume floor space, are unsightly and do not belong in new construction. In renovated space they should be used as a last resort only.

The structural design should serve the electronic technology needs as much as is economically feasible. This may suggest long structural elements spanning between structural masonry walls or structural columns. Demountable partitions between areas of use are expensive; light masonry unit walls may not provide sufficient flexibility for services needed. A 36"-48" wide chase near the center of the wall may provide an acceptable solution to that problem. Metal stud partitions provide the most economical alternative for concealed wiring and cables, however, they can be more susceptible to damage, however.

Retrofitting existing buildings should be done on the basis of over-all feasibility and trade-off studies that include all major building components. Drilling through structural concrete elements is costly or not feasible. Surface mounted cables and wires are likely to provide the desired flexibility at lower cost, provided that attractive and maintenance-free designs for raceways can be found.

ELECTRICAL POWER

An analysis of the potential and future power usage to support the technology base within schools should be done prior to construction. The analysis should, at a minimum, consist of the following parts:

- The total amount of power required by the facility
- The condition of power required
- The grounding situation within additions, new, or existing facilities
- The specific location of outlets to support technology equipment

THE AMOUNT OF POWER

The total amount of power required is determined by the summation of the individual power requirements of all systems and technology equipment. Power requirements are usually listed in equipment manufacturers' specifications. Note that power loads for computers are non-linear and generate harmonics due to the switching power supplies used. They may require ground returns twice the size of normal linear loads.

The Institute of Electrical and Electronic Engineers (IEEE) and the National Electrical Manufacturers Association (NEMA) standards, as well as local wiring codes, should be reviewed with electrical design engineers, potential electrical contractors and potential technology equipment vendors.

THE CONDITION OF POWER

Because of the non-linear load characteristic of computers and the protection required by semi-conductor devices, it may be necessary to provide surge protectors, power back-up, and regulation devices. Fast action surge protectors are used on individual units to protect against power surges or spikes.

Where the installation of dedicated circuits is not feasible or practical, computer equipment must be isolated from devices such as motors, air conditioners, and heating equipment that produce such spikes. Since the power supply to a facility may fall below rated power potential or be interrupted for short periods, backup of file server units or centralized larger computers with uninterruptible power supplies (UPS) may be desirable.

UPS systems can be divided into Plug-in, Intermediate, Hard-wired and Engineered systems. Engineered systems tend to be costly and more sophisticated than needed for schools, and Intermediate systems have not yet found widespread use in schools. Plug-in UPS systems are small (100V-15kV) and almost always single phase. They are bought, delivered, and plugged into either 115- or 220 volt sockets where they are needed. They have little or no impact on the school's electrical system. The basic operating designs for UPS systems are Off-line, Hybrid, and On-line. Off-line systems are standby systems that feed raw utility power directly to the computer and provide backup power from sealed cell batteries, similar to automobile batteries. Batteries weigh 60 - 100 lbs each, maintenance is limited to cleaning and tightening the terminals. Battery life may be up to ten years. Off-line systems are small, inexpensive, lightweight and efficient, but they do not protect against spikes, surges, sags, and noise--all of which can cause loss of data. Off-line systems designed for backup lighting are unsuitable for computer use. In the final analysis, the system to use should be based on the recommendation of the design engineer for the project.

In Hybrid UPS systems utility power is fed into a conditioner that eliminates spikes, surges, sags, and noise. Clean power is then sent to the computer. Hybrid systems are more expensive, noisier, and less efficient than Off-line systems.

On-line is the dominant UPS system. It is available in some plug-in and most hard-wired UPS systems. Utility power is fed into a rectifier that converts it from AC to DC. The DC power goes first to a battery pack, then to an inverter that converts it back into clean, computer-grade AC power. Because the batteries are "on line" there is no time lag when switching to battery power. On-line systems provide the most complete protection and are the most costly, the heaviest, and least efficient.

It is usually more economical to provide small individual battery backups for central file servers rather than large central units for power lines. It may not be economical to backup each individual work station unit. A review of the power condition requirements should be conducted and reviewed with potential technology equipment vendors.

Worth considering is an option where a local utility company is able to provide uninterruptible power for a monthly fee. In such a case the utility company installs a battery/transformer unit at the customer's service entrance. When necessary, the unit converts the AC current at the entrance into DC current and back again into AC.

THE GROUNDING SITUATION

Because computer networks and other technology equipment span entire facilities, their interconnection provides ground paths over which electrical noise and spikes may be transmitted and interfere with the operation of equipment. It is, therefore, important that common ground be provided for entire buildings and, where additions or renovations are contemplated, the grounding system between older and newer portions of the building be connected via common grounds. A review of the facilities' entire electrical grounding situation should be conducted with an electrical contractor.

THE LOCATION OF OUTLETS

A technology equipment location plan is an essential part of design. It must be a part of, or at least coordinated with, the Design Development documents and subsequent design and construction phases of a school facilities development project. A plan that reflects the design of activity areas in accordance with the educational specifications will aid in preventing mistakes such as locating power outlets behind markerboards or telephones with modems by classroom doors.

A sufficient number of power outlets or power strips must be provided in the same proximity where equipment is to be installed. Typical power cords are in the range of 4 to 8 feet; provide outlet plugs within this range; allow for line slack. Coordinate power outlets in the same proximity to network wiring outlets. Power outlets for dedicated circuits should be color coordinated or otherwise clearly marked.

Many telephone and computer network wiring closets also include active transmission devices that require outlet power; therefore, outlets must also be provided in wiring closets.

It is recommended that furniture layouts for affected activity areas be on hand prior to planning outlet locations.

NOTE THAT THE SCHOOL WITH A FULL COMPLEMENT OF ELECTRONIC SYSTEMS DEMANDS A COMPLEX POWER DISTRIBUTION SYSTEM. The electrical engineering design for it must be well executed. Therefore, consider recording in the edspecs that the architect and consultant engineer prepare a checklist of specific action items for the owner's review before beginning the design development documents. Base the checklist on the four parts described above.

LIGHTING

Evaluate the adequacy of lighting for any particular task in terms of two components: quantity and quality. Proper lighting is particularly critical to electronically oriented tasks, as the equipment is unforgiving of improper lighting. Where monitors are used, improperly designed lighting can lead to glare, eyestrain, and loss of efficiency on the part of users. In television broadcasting, improper lighting yields unsatisfactory picture quality.

QUANTITY of lighting should be appropriate for the task on hand and never exceed that of classroom lighting (30 - 70 foot candles). If anything, err on the side of much lower light levels where monitors are used.

> Provide low level ambient illumination, combined with task lighting, for proper illumination on printed materials used in conjunction with computers, where appropriate.
>
> Ambient lighting levels for offices range from 50 to 70 foot-candles (fc), drawing 1.5 watts per square foot or less. Federal standards require 1.5 w/fc as the limit for government facilities with large office needs.

QUALITY of light. Glare is the factor most detrimental to user efficiency. Consider the following:

> The worst: Lay-in fluorescent fixtures with acrylic lenses. They are guaranteed to create glare.
>
> > Traditional lenses and shielding media in recessed troffers are inadequate for both monitor screen glare control and energy efficiency. Low brightness lenses are not effective in controlling screen glare reflections.
>
> Slightly better: Lay-in fluorescent fixtures with parabolic lenses.
>
> > Compound parabolic louver assemblies are designed to control all light emitted by the luminaire in the range of angles reflected by the monitor screen.

Best: An indirect lighting scheme, such as stem-mounted uplights, possibly incorporating parabolic lenses for a small percentage of downlight. Ceilings painted a pale gray is appropriate.

> Indirect lighting systems are most efficient and produce a more uniform distribution of light where ceiling heights are 10 ft, or greater.

Small-cell injection-molded plastic louvers are good for glare control but inefficient, resulting in power consumption of 2-2.5 w/sf for needed lighting levels.

The predominant use of fluorescent lights is due to their long life, low cost, and reduced heat output. Fluorescent lights used in computer areas should have their own power feed if "dirty" power detrimental to electronic equipment is to be avoided.

Natural light is prized by most people. While it may be difficult to control, it is essential to the well being of people. It will, therefore, contribute significantly to a facility that is stimulating to both learner and teacher. Clerestory windows and selective use of skylights may be an option; windows to the rear or to the side of users create glare on monitor screens; windows to the front create eye strain due to contrasting illumination levels. Windows in computer-use areas must, therefore, be provided with adequate shading.

Window treatment: The orientation of windows determines to a great extent which form of daylight control is most appropriate. An exterior horizontal "eyebrow" or overhang as part of the structure serves to block sky glare. Shades of an opacity compatible with the window orientation diffuse entering light and are relatively dust-free and inexpensive. Vertical or horizontal blinds work better on northern exposure but require maintenance. Horizontal blinds, unless sandwiched between window glass, collect dust. Curtains cut incoming light and improve the acoustics but give off fibers and collect dust. Tinted glass should be considered as another option.

Painting the walls behind the monitors a matte finish helps to reduce glare; choosing a darker color that compliments the monitor screen helps to reduce eye strain by reducing the contrast between the monitor and the wall.

Modern TV cameras are sensitive enough to transmit adequate picture quality under light levels suited for most tasks. Care must nevertheless be given to lighting design in areas where TV cameras are used.

CLIMATE CONTROL

The option to rearrange instructional areas must be designed into schools, including those slated for renovation. This requires HVAC distribution systems and flexible runout ducts that respond to change with a minimum of effort and cost.

Electronic equipment and software requires a climate controlled environment. Temperatures should be kept between 68° and 78° F. and relative humidity should not exceed 60% year round. Spaces such as wire closets, electronic equipment rooms, software storage, etc. as well as instructional and administrative areas, must be included. Removal of dust and equipment-generated heat is needed for proper operating conditions. A typical computer with a laser printer generates about 4100 BTU/hr heat.

In activity areas with a considerable number of electronic equipment, particular attention must be paid to the placement of windows, heating units, fans, and ceiling diffusers. Air currents carry with them dust that, when it gets into sensitive electronic equipment, is certain to cause mechanical problems.

Particulate control is achieved with relatively inexpensive fabric filters. If static control is also required, then the more expensive electrostatic precipitators are recommended. Frequent changes of filters in air handling ductwork is recommended.

Controls that regulate individual instructional environments for optimum human comfort and operating efficiency should be considered for today's schools. As load demand changes during the day due to class size and number of computers in use, such controls would allow teachers to make immediate adjustments without detriment to the climate control system or the need of service personnel. Administrative and other areas can benefit in a similar manner.

CLIMATE CONTROL SYSTEMS

The automatic control of heating, ventilating, and air conditioning (HVAC) systems is one of the more obvious and economical applications of technology. Pay-back periods can be very short. Modern Direct Digital Control (DDC) systems offer the following features:

- Various components of each HVAC system can be controlled and monitored from one or several central locations by means of microprocessor-based monitoring points. An authorized person in a central facility turns on the heat in the gym for after-hours programs and, after the program, turns the heat down--all without being in the building. Monitoring the condition of any building in the entire school system is also possible.

- The system's operation can be altered to suit interior and exterior climatic conditions to achieve maximum efficiency.
- A DDC system is capable of warning of changes in the operational and maintenance status of the monitored systems and is capable of sending alarms to appropriate persons.
- Systems are adjusted in accordance with changes in the use of spaces within the building.
- A DDC system is capable of recording and reporting on energy consumption.

Computerized systems for scheduling and tracking preventive and routine maintenance work orders are available. A description of the desired level of performance of such systems should be written into the edspecs. These systems document equipment and facilities repair activities; they may be linked to an LEA-wide asset management program.

Furthermore, climate control systems could be used for instructional purposes provided that the operator workstation is accessible to groups of students. An alternative solution worth considering is to install a slave monitoring station in an instructional area.

FIRE/LIFE SAFETY

Traditionally these systems consisted of electrical devices that worked well, provided that they were well installed and maintained. Drawbacks: complex wiring can be costly and labor-intensive to install and expensive to maintain. There is also a limit of 20 devices per pair of wires.

The complexities of a fully electronic microprocessor-based fire/life safety system reside not in the hardware but in the software. When considering such a system, the following features must be kept in mind:

- The reduced amount of wiring in electronic systems reduces wiring errors.
- Systems can be reconfigured in a matter of minutes or hours.
- Wiring changes are minimal; often the mere addition of a pair of wires may be all the work that is required.
- Trained technicians are required.
- Individual areas can be tested separately while the rest of the system is operational.
- Systems can respond automatically to a fire by releasing fire doors and controlling HVAC equipment.
- Systems can be programmed to prompt an operator and wait for a command.
- Voice messages can be digitized and spliced. They can instruct students and staff to move, and to broadcast the exact location of a fire for fire brigades.

It is recommended that the electronic microprocessor-based system not be integrated with any system that controls HVAC, power distribution or other building management functions. Networking problems can reduce reliability and therefore diminish efficiency. Operation must be at 100% efficiency 100% of the time.

SECURITY

It is advisable that security systems be considered, at minimum, for data security areas and high investment technology areas such as computer labs and interactive TV classrooms. While electronic microprocessor-based security systems can technically be integrated with HVAC controls and energy management, access control, and closed circuit TV, it is recommended that the security system remain independent. The advantages and capabilities of security systems are similar to those listed above for Fire/Life Safety Systems.

Each school should develop a building security plan based on:

- The routine operations that require protection from unauthorized access and where and when such operations are performed.
- The identification of threats: who are most likely to pose that threat, how would they gain access?
- The assignment of temporary security space for computers and other electronic technology delivered to the site during construction.
- The provision of dedicated and secure storage space for computers and other electronic technology prior to set-up in the school.
- The provision of interaction between the security system and the telephone system to allow feedback from various locations in the building with designated personnel and central security staff.

Detection systems may be predictive or reactive. The former include photo-electric and infrared detectors used for building exteriors. They generate narrow beams focused on sensors some distance away. Anything that breaks the beam triggers an alarm. Area-type detectors operate on the Doppler principle: A transmitter floods an area with ultrasonic or radio waves; sensors monitor any shifts in the frequency of reflected waves, triggering an alarm. Reactive sensors are usually mounted on doors and windows. Opening a door, breaking glass or creating vibration triggers an alarm.

Electronic microprocessor-based security systems should be designed to provide effective communication among sensors in the building and central security staff. Systems with over sixty security zones or "points of protection" -single security sensors or series of sensors in circuits- are possible. These systems are flexible and cost effective. Zones are designed to receive and send information from heat, light, and sound sensors. They can dial out alarms to a central location on one telephone number while staff dials in on another one to listen, verify and follow up. Only single-line telephones are needed for voice communication and security surveillance. Systems can be programmed to determine whether individual zones will be "secured" or "accessed" during the day or night.

Systems should be operated by a digital keypad connected to a control panel, both installed in a protected space. The control panel contains a digital communicator that transmits emergency signals over telephone wires to the LEA central station. Battery back-ups for the security equipment are desirable.

Access Control. Individual access systems for each protected area should be provided with separate, programmable digital coding (four digits minimum). Each area should have separate reporting codes. Automated access control using plastic cards is available. The user inserts the card into a reader to gain access. The system may be programmed to allow selected individual access only during certain hours.

CCTV. Closed circuit TV monitoring systems can be configured to enable guards to observe and, if needed, to record suspicious behavior. Cameras could be installed in unobtrusive housings on ceilings. They could be equipped with pan-tilt mounts and motorized zoom lenses.

Security systems transmitting security data over standard data networks should have a back-up communication link--usually an automatic dialing system--in the event that the network goes down for some reason.

ACOUSTICS

Sound is measured according to loudness and tone. The former, referred to as sound pressure, is measured in decibels (db). The human ear does not respond to true sound pressure, hence decibels are weighted to measure sound pressure "as we hear it" (dbA). Tone, referred to as frequency, is measured in cycles per second (Hertz or Hz).

It may be desirable to include in the edspecs acceptable noise levels for specific activity areas. Acceptable noise levels for large office areas (40 - 50 dbA) may serve as a reference point. Obttain specific recommendations from qualified consultants.

Uncontrollable exterior noise can be reduced significantly by a large mass of material in the exterior walls. Sealed, double-glazed windows help to reduce exterior noise. HVAC-generated noise can be reduced by placing fans in remote locations, mounting equipment on vibration-reducing isolation pads and, in general, not placing HVAC equipment directly over instructional areas. Air turbulence in ducts may be reduced by proper design.

Electronic "white" noise generators are useful in masking interior noise. They function at frequencies close to those of speech. A microcomputer-based active sound control or "sound cancellation" system is costly, but it may be warranted in cases where effective sound control is essential. Such a system works as follows: a microphone mounted within a duct detects a noise and converts it to electric signals. A controller processes the signals and generates inverse or mirror-image waves that cancel the noise waves in pipes or ductwork. The canceling wave is broadcast by a loudspeaker mounted to an opening in the duct.

The human ear filters out much interior noise, but a microphone does not. Consider, therefore, proper acoustic treatment for broadcasting areas such as 2-way interactive TV classrooms.

Computer-generated noise may be a sufficient reason to consider acoustic treatment beyond simple acoustic lay-in ceiling tiles. Computer labs, business education classrooms, and other areas housing several computers will benefit from wall coverings such as acoustical panels and glued-on ceiling tiles.

For permissible noise exposures in noise-generating activity areas noise (i.e., some career and technology education labs), please consult the Code of Federal Regulations, Title 29, Part 1910.95, Occupational noise exposure, latest revision.

BUILDING SUPPORT

Numerous areas in the school are in direct support of both administration and the instructional program. These support spaces may benefit from the judicious use of technology yielding efficiencies in energy consumption, maintenance programs, and security.

Controls for support systems such as voice and security should be centrally located and accessible from the administrative area. While this is also desirable for HVAC and electric power, these may be more economically located in the mechanical room.

ANTENNAE

A terrestial survey done at the school site to determine the best location for a satellite dish or other antennae is recommended. The survey is best done prior to developing designs for a new school or for alterations and additions to an existing one. The survey may have an impact on roof design or on the location of some building functions.

EQUIPMENT REPAIR AREAS

Computers and other electronic devices in the building need to be serviced and repaired. Space must be provided alongside some equipment for technicians to perform service on the spot or take them to a central repair location in the building. This location should be:

- A secure room, preferably in the Library/Media Center area and near the equipment to be served.
- Supervisable by Library/Media personnel.
- Power and climate control shall be in accordance with the recommendations in this document. Please refer to the sections "Electrical Power" and "Climate Control" beginning on pages 23 and 28 respectively.

WIRING AND CONDUITS

Cable and wire conduits for voice, video and data systems vary. A representative range may be from 1" to 4". Conduits may be of metal or PVC. No signal wires must be placed in the same conduit with power wires; magnetic fields surround power wires that disturb the signals transmissions along signal wires. Proper grounding and shielding of all wiring is important. Fiber optic cable, however, is immune to electrical interference.

Voice, video, and data systems, including the above building support systems, require wiring. The chart on the next page is a comparison guide for the more commonly used subsystems:

Comparison of Horizontal Wiring Subsystems

Cabling system Main characteristics	Raised floor	Underfloor ducts	Raceways	Plenum	Under subcarpet
Cost	High	Low	Medium	Low	Medium
Flexibility	High	Limited	Limited	High	High
Expandability	High	Limited	Limited	High	Good
Accessibility	Good	Limited	Medium	Poor	Good
Appearance	Good	Good	Poor	Powerpole unsightly	Good

DISTRIBUTION SPACES

Maximum allowable cable or wire distances (usually 1000 ft.) determine the spacing and location of wire closets. It is important that they be large enough for servicing the equipment they house from both sides and meet applicable fire and life-safety codes and regulations. Wire closets require temperature control. Please refer to the section "Climate Control" on page 28.

Many network wiring closets include active transmission devices that require outlet power; therefore, outlets must be provided in them. Providing a standard telephone jack is also recommended since wire closets are frequently shared with voice systems.

Provide a common ground, isolated from other grounds in the building for each wire closet.

Lighting provided in wire closets must be adequate and non-fluorescent.

The equipment in wire closets generates heat. Year-round climate control is therefore recommended. Design for 50°-85° F and maximum humidity of 70%. Provide tight seals around doors and openings through walls and ceilings to provide a dust-free environment. For the same reason, surfaces should be non-porous and painted or sealed.

Wire closets should be located away from possible sources of electromagnetic interference such as electric motors or transmitters. Do not locate below restrooms in multi-story schools; running water and sewer lines with exposed valves and cleanouts in or on wire closet partitions must be avoided.

Wire closets must be used solely for (dedicated to) the service of electronic technology and must not be used for other electrical or mechanical functions or as janitors' closets or for storage.

FINISHES

In spaces containing electronic equipment consideration must be given to static control, acoustic control, and dust-free maintenance.

STATIC CONTROL is critical to avoid damaging electronic equipment. Avoid metal-to-metal contact of furniture; avoid metal casters. Carpeting should be specified with a static rating of 2.0-2.5 kv or less. Anti-static sprays do not last; treatment may be repeated as often as 2 or 3 times a week, an added expense. Anti-static mats are expensive; anti-static bars are a less costly option.

ACOUSTIC CONTROL is necessary for the control of transmitted and reflected noise. Computers and peripherals, particularly dot matrix printers, are noisy. Noise is undesirable in any occupied space; it can be transmitted through and around walls and ceilings to adjacent spaces. Carpeting, acoustical ceiling tiles and, in many cases, wall panels are essential to control reflected sound. Masonry walls and cavity insulation in partitions reduces sound transmission.

Classroom computers and printers (unless inside sound enclosures) may be located in a separate space for noise reduction purposes. However, immediate viewing of printouts may be an inconvenience.

DUST-FREE MAINTENANCE should be part of every school's operations and maintenance policy. After-hours cleaning by custodians stirs up dust, including chalk dust. Air filters in air handling ductwork is, therefore, strongly recommended. Electronic equipment is sensitive to dust, and computer equipment must generally be cleaned and reconditioned within three years of use. Computer maintenance contracts are worth considering.

ACCEPTANCE TESTING OF SYSTEMS

In buildings that will contain data processing or data communications systems, the requirements of the National Electric Code (NEC) will not necessarily provide an adequate electrical environment for reliable and error-free operation of the installed equipment. If this is a concern for a particular school facility being planned, a qualified specialist should be hired.

The electricity-based systems presented in this Model are interrelated. Every system must be tested individually and separately. An acceptance plan should be written for individual equipment, each vendor's equipment and the overall system. The acceptance plan should include specific dates, criteria for passing and contingencies should failure result.

It is recommended that shortly after installation of each system, the applicable equipment be hooked up, and the system be tested by the contractor who must have the technical qualifications to perform the test. After the discrete systems have all been tested, an overall, complete school-wide systems testing must similarly be performed.

Education and training of assigned staff of the user should be part of each vendor's service package.

SECTION III – ACTIVITY AREAS

Traditional labels for a school's activity areas may be no longer appropriate and the traditional groupings no longer acceptable in cases where instruction and classroom management are supported by a technology infrastructure. As the belief statements suggest, it is not only appropriate but desirable to think nontraditionally when planning "technology-friendly" spaces.

The school as a place for six to eight daily hours of instruction belongs in the past as many communities now demand telecommunications and physical access before and after normal school hours. Library Media Center services and the facilities for Career and Technology Education are among those. School facilities are needed for such services as day care for children with working parents, adult education (including programs for completing high school), and evening meetings and special programs by a variety of community groups.

Schools must be planned to function twenty-four hours a day. Thus, at any time voice systems can link callers with recorded information, video systems can transmit school-related items to home television or computer monitor screens, and modem-equipped computers may access many of the school's data systems. This new role of the school has a profound impact on security and classroom design and will affect the way we plan our buildings for the future.

As was noted in the preface of this document, increasing the levels of technological complexity now requires a full-time staff person to support the technology and provide assistance in its use as an instructional and management tool. In larger schools this is an in-house service, but all schools should, at the very minimum, receive support and assistance on an on-call basis at the local school system level.

The suggested edspec format for each activity area grouping is set forth in the Format Guide for Educational Specifications, Section IV -- Activity Areas. As suggested in that section, the activity areas are the core of educational specifications. Those that are related by teaching objectives and learning outcomes are grouped under a single heading. Some activity areas serve more than one function and qualify to be listed under more than one heading. Determine the most likely main function of the area, then place it under the heading most appropriate.

It is recommended that specifications and requirements for electronic technology for each activity area be limited to unique requirements for that area. Refer to Section II Building Components for systems pertaining to activity areas as a whole.

Example: A classroom with computer clusters will require special lighting considerations to avoid glare on monitors.

This subject is covered under "Lighting" in Section II. If the classroom requires a particular form of daylight control, it should be specified within the description of that activity area under the category "Lighting." The format is suggested in the Format Guide.

For detailed information and recommendations, such as dimensions and space allocations for workstations, please refer to Appendix C in this document.

Electronic linkage of curriculum areas also fosters a new level of flexibility among space assignments. It should be understood that activity areas are not limited to spaces dedicated specifically to instruction. All activity areas should be identified, and each one must be included in one of the following major groupings:

Administration
Food Service
Guidance
Health
Instruction
Instructional Support
Library Media Center

Under Instruction are located sub-headings such as Career and Technology Education, Art, Music, Physical Education, Science, Special Education and others.

Spaces traditionally exempted from activity area status, and not usually part of educational specifications, include certain support spaces, such as mechanical and boiler rooms, workrooms and custodial facilities associated with them. Toilet facilities for building-wide use and janitors closets have also been traditionally exempted. However, because of increasingly sophisticated building controls, these areas should be part of a comprehensive edspec.

Another specific area may be the equipment room, a space set aside for communications equipment and a must for large schools with switching apparatus such as a PBX or LAN. The technologies for these areas are best covered under Section II -- Building Components.

The major groupings listed above are common for all elementary and secondary schools. Only in rare instances does one find all of them in a single facility.

Persons entrusted with developing educational specifications must be able to anticipate problems related to telecommunications. This requires understanding the functional needs brought about by new technology-supported teaching. Knowledge of the following is required:

- Various facility-related problems that teachers, staff, or students may encounter with information transfer.
- Those activity areas that may require electronic equipment.
- The number of computers that should be provided per some unit such as student, classroom or school.
- Methods of guiding staff and teachers toward some of the activities that should take place in technology-supported spaces.

ADMINISTRATION

The administrative offices are the nerve center of the school. It is the point of contact between the school and the community and its services, such as police, fire and rescue departments. The design and technology for this center must support the school's operational plan, whether centralized or decentralized, as well as meet the needs of students, staff, parents, and community members using the school's services.

Telecommunications within the administrative areas must be designed to support and link all school programs and satisfy all information management needs. Consider providing a designated communications area within the administration offices. Check the boxes of the following list when specific action has been taken on each item.

☐ Immediate access to student records and emergency data must be provided. Sufficient terminals and keyboards will allow simultaneous clerical use of equipment.

☐ Provide multiple phone lines for school-parent communication. Staff must be able to easily send data system-based information to student homes.

☐ General public information access must be provided 24 hours a day.

☐ The type of voice systems that best meet the needs of the school should be spelled out.

☐ Data relating to attendance, maintenance, scheduling, and student services may originate from workstations anywhere in the school building. Direct links must be provided to the administrative offices.

☐ Principals and staff should have teleconferencing capabilities with other schools.

☐ Administrative staff should be able to communicate with each other and key building personnel throughout the building by means of wireless devices, including access to the public address system.

☐ Principals and other key personnel should have telecommunications capability at home to enable them to access and monitor school information and controls.

☐ Work space must be provided for planning and executing methods of electronic recording of information, development of records, and testing of software.

☐ Computers should be located at all teachers' desks with access to an administrative mode and connections to printers.

☐ Provide fax machines or integrated fax-modems in computers.

☐ Facilities and technology must be provided for the production and reproduction of printed materials, including official correspondence.

☐ Facilities must be provided for electronic storage and retrieval of information. Fireproof storage should be sized to accommodate program disks and various backup and duplicate material.

☐ Video surveillance should be provided for security purposes.

☐ Consider providing headsets matching the phone system for clerical staff who need to work with both computers and telephones.

BUILDING SUPPORT

Technological applications for the operation and management of building systems (i.e., climate control, fire/life safety, etc.) may be located in a building manager's office, work room, or in a suitable area of a mechanical space.

Provide the necessary work station and storage space, proper electrical power circuitry, telephone, modem, etc., for a fully operational building management system. Provide secured software and records storage if administration of the school is decentralized. Provide proper access and area security control.

FOOD SERVICE

The modern school food service area must maintain and communicate a wide variety of data at the same time it is performing its traditional function of providing food service to all populations of the school. In the foreseeable future it will be likely that students will possess magnetized ID cards that will be used to monitor and record eligible school lunch purchases. The same card will also be used on school buses and for checking out media materials. Food service specifications and layouts should anticipate the use of this technology, aleady in use by the US Army, for instance.

The electronic technology located in this area must be able to collect and compile auditable data as prescribed by state and federal regulations under entitlement legislation on behalf of the school and its population.

Consider computerized cash registers that can supply information directly to the local school system and MSDE. Locate them at each end of the serving line.

Consider providing the food service manager's office with computer capability for making weekly food purchases through the local school system. Such an office must be climate controlled.

The food service staff must provide accurate and timely data to the county or city central food services office. The information needs are listed on the next page and include

- Proper POS (point-of-sale) identification of all eligible meal reimbursements
- Evidence that federal legislation-mandated "Accuclaim" requirements are met: all meals contain required components, and eligible recipients are limited to one reimbursable meal
- POS terminals that are linked to one on-site computer with on-line processing during meal service
- Data transfer capability from that computer to the school system's Food Services office
- Capability to process applications, maintain data and print eligibility lists
- Meeting check requirements for "Accuclaim" regulations

GUIDANCE

Technological applications for the guidance office are tied to several administrative applications such as scheduling, registration, records, and attendance. Guidance applications should be included in the schoolwide LAN, not just in the LAN dedicated to that office.

In addition to work stations for counselors and guidance staff with computers connected to the LAN, terminals are required for student use in an outer office/reception area. This is because major guidance applications address information for students as well as information about students.

Provide appropriate software and video to support guidance activities.

Specific technology-related requirements include:

> ELECTRICAL POWER: Provide a minimum of three electrical outlets per workstation.

ELECTRONICS: Student-use work stations located in the outer office should be equipped with a VCR or interactive TV in addition to a computer and printer. Provide sound enclosures for other than laser printers .

Provide a high performance printer for the staff.

Provide a reader/scanner for the processing of career assesment inventories, surveys, referral dispositions, etc.

Provide an automatic phone caller for communicating information to parents.

HEALTH

The health suite provides first aid and health counseling and dispenses prescribed medications. It should provide a safe and private area for handling health issues and a secure place for maintaining health records.

The health suite is preferably located on the ground floor, adjacent to the administrative offices and guidance, with easy access to automobiles and ambulance. The suite should be linked to them by telephone, including an intercom, and a security system. Address the following:

ELECTRICAL POWER: Provide electrical outlets in suitable locations for diagnostic tools, digital thermometer, etc.

Provide a minimum of two electrical outlets on a dedicated circuit for a computer terminal. Outlets should be color coordinated or otherwise clearly marked.

ELECTRONICS: Provide linkage to the administrative computer network. Provide the school nurse with a computer terminal in the health suite office for searching records of truant or suspended students, and those with repeated absences and/or illnesses.

Provide a telephone for the nurse as well as students.

INSTRUCTION

The instructional activity areas, defined for the purposes of this section as the classroom, seminar rooms, and laboratories, are the focal point of the school. They are where students and teachers spend most of their time. The technology used in these areas must support the instructional program. Housing the instructional program and making the school building part of that program should be an objective.

The technology must also address the administrative responsibilities of the teacher to minimize time spent on noninstructional activities. Similarly, the technology should make maximum use of student learning time. Electronic technology in support of instruction may include, besides the obvious computers and television, such items as lasers, electron microscopes, fiber optics, robotics, etc.

Technology must, however, not supplant concerns for student development. Create classrooms that reflect the presence and importance of youngsters and increase their competency by having the physical environments designed and scaled for them; where equipment is age-related and space comprehensible and logically organized.

The stated goal for Maryland schools is to provide at least one computer for every 10 students by the year 2000. The goal is a state average, new and renovated schools should exceed this average.

The effective use of available technology and software in the school requires frequent and intensive teacher training. It is recommended, therefore, that an activity area or a portion of one be assigned for this purpose. It may be shared with other activities.

Teacher-focused technology must address the issues on the following list. Check the boxes for those items on which specific action has been taken.

☐ Computers should be linked to the administrative suite for registration, attendance and record keeping.

☐ Computers should also be connected to the school library media center and external curriculum resources for direct access to current materials.

☐ Computer linkage should be provided to other classrooms and schools by means of networks.

☐ Providing a video network would permit sharing VCRs and players. Please refer to to the sketch "A Telephone Center and CATV/VCR Dial Retrieval Layout on page 76. Backup equipment may be desirable.

☐ A computer and printer should be located at the teacher's desk in the classroom and the planning area. Consider assigning each teaching team a VCR and a TV.

☐ There should be the capacity for data storage on individual pupils. A security system should be provided for teachers' work.

☐ There should be multimedia access for teachers and the capability to display images to the entire class.

☐ The capacity to create instructional materials should be provided.

☐ The teacher should be able to control all computers in classrooms and labs.

Student-focused technology should address the issues listed on the next page. Check the boxes for those items on which specific action has been taken.

☐ There should be computer access to library media centers from within and beyond the school building before and after regular school hours.

☐ There should be a sufficient number of networked computers to permit ready and unscheduled access by students before and after regularly scheduled classes.

☐ Students should have access to interactive videodisc, CD-ROM and distance learning technologies, and to television with videotaping capability.

☐ Students should have access to home assignment information on classroom computers from their home computers.

☐ Students should have access to high-quality printers and desktop publishing. As color printers become more affordable and common, they should be considered

☐ Adequate staffing for technology should be available to students. Staff must be completely familiar with the software in use for instruction, and the purpose and use of available hardware, including peripherals.

☐ There should be electronic mail capability to contact other students at levels ranging from local to global.

☐ The size and resolution of computer monitors must be adequate for use by small groups and for extended time periods.

☐ Appropriate software libraries aligned with the school curriculum should be installed and copy protected on the network and on diskettes.

☐ Password security systems should be created for student work.

☐ Modifications of select computer hardware and workstations must be made to accommodate the physically handicapped.

THE GENERIC CLASSROOM

The changing environment of technology-driven instruction and the proliferation of computers demand a classroom design flexible enough to accept multi-media support of instruction from any place within the classroom. Furniture and equipment layouts must not be dictated by inflexible placement of building support systems. The space must lend itself equally well to the placement of furniture and equipment in support of "traditional technologies" as to new demonstration techniques and ways of work. This suggests in-the-floor systems terminating in floor outlets, conventional wire and cable runs in walls and possibly systems in horizontal wall conduits. For one approach please refer to Appendix B, page 75.

This change further suggests that a small (shared) teachers' office between their respective classrooms be provided. Only little, if any, space is necessary as some of the teacher functions are transferred from the classroom setting to the office. Large glass areas provide visual access to the adjacent classrooms.

- ○ The teacher command center should always be positioned in the best location for the teacher and multimedia support of instruction

- ○ The classroom should contain a cart-based portable computer station complete with a projection system or hookup to the classroom TV receivers and printer, paper tray, laser disk player, modem, and a VCR. The power cord should reach the nearest power source (on a dedicated circuit) without extensions.

- The classroom should accomodate the use of camcorders mounted on a copying stand. Such a device would serve to project and record visuals and demonstrations that are difficult to prepare and last only seconds. Recorded, they can be viewed again, repeatedly. A hookup to TV receivers is desirable.

- Provide a (ceiling-track mounted) pull-down screen. Because computer images projected on walls lack clarity, use a 4×5 ft. clear, white, and absolutely smooth wall surface only as a last resort.

- Allow for a projection space or a ceiling-hung projection unit in (the rear of) the classroom.

- Provide a secure storage cabinet for manuals for all programs, software, printing paper, blank disks, copies of various programs for student use, and other miscellaneous supplies.

- Every student in the classroom must be able to view programs on a color television receiver. Where a single receiver is the only (albeit less desirable) option, provide one with a 47 - 60 inch screen. To effectively reach all students, a minimum of two receivers with 25 - 27 inch screens is recommended. The receivers should be permanently mounted on carts, wall or ceiling, low enough to reach the controls and attachment ports. Large screen rear/screen projection sets with closeable doors to protect the screen surface may be an alternate option.

- Computer clusters or mini-labs should be provided depending on curriculum requirements. Please refer to the chapter "Instructional Support" on page 59. These mini-labs should be planned as environments for small group electronic education and work. If a classroom is equipped with a single computer, students perceive their chances to use it as minimal and will avoid its use. Using the single computer for telecommunications, whole class data storage, and as a creativity work station will enhance its use somewhat.

- Locate the computer mini-lab in shared spaces within activity areas, outside the traffic flow and out of the sight lines of students and away from running water. This allows other instructional activities to occur simultaneously.

- All computer stations in secondary school classrooms must be provided with space for bookbags and personal effects and sufficient writing surface. Tables and workstations that accommodate wheelchairs should be provided for all grades and age groups where needed.

- Provide markerboards and "liquid chalk" markers in lieu of chalkboards. Computers and other electronic equipment can be rendered inoperable by chalk dust.

ELECTRICAL POWER: Provide outlets for connecting computers to the building-wide network. Provide outlets for printers and other peripherals. Group the outlets for computers, standard power, TV, and a modular telephone jack convenient to the teacher's command center. Outlets on dedicated circuits should be color coordinated or otherwise clearly marked. Provide in-floor conduits and floor outlets in computer mini-labs and as required. Wall outlets should be at counter or desktop height.

ELECTRONICS: Provide in-floor conduits for cabling and twisted-pair wiring. TV outlets and telephone jacks should be reachable from the teacher's command center and mini-labs. Standardize modems on a 2400 minimum BAUD rate and Hayes compatibility.

Note that electrical power and signal wiring to classrooms should be adequate enough to provide computer-use capability for each student, based on the design capacity of the classroom. A full complement of laptop computers could thus be brought to the classroom whenever a lesson plan should so require.

LIGHTING: Ambient lighting must be controlled to avoid glare on monitor screens. Painting the walls behind the monitors a matte finish helps to reduce glare and chosing a darker color which compliments the monitor screen helps to reduce eye strain by reducing the contrast between monitor and wall.

Indirect lighting, obtainable through stem-mounted uplights is desirable. For more on lighting and lighting control, please refer to Section II -- Building - Components.

CAREER AND TECHNOLOGY EDUCATION

Preparing students for entry into careers and to pursue lifelong learning are Maryland's dual objectives of education. The premise is that they must be achieved within a single, integrated system. Instructional preparation for career and non-career roles are intertwined and cannot be meaningfully separated. Career and technology education is therefore an integral component of instruction; linkage to the entire school and select facilities beyond is provided by networked voice, video, and data systems.

Career and technology education includes technical centers where locally administered career and technology programs serve students from feeder schools. These programs, and administrative support, should be directly accessible to the secondary schools in the region the center supports. This access should be over suitably integrated voice, video, and data systems. While career and technology education facilities in centers vary in scope from those in comprehensive high schools, linkages can be tailored to suit.

Because of commonalities in learning environments, technology education (formerly known as industrial arts) has become a part of Career and Technology Education. The three broad areas of technology education are communications, power and energy, and manufacturing. Each has specific requirements and uses for electronic technology.

Classrooms and labs should replicate industry-specific state-of-the-art technologies and, where possible, look toward the future. They must reflect as nearly as possible the environment that students can expect to find in a changing and dynamic world of business, construction and service industries. This may require special-equipment laboratories such as CAM (computer-assisted manufacturing) labs.

Administration-focused technology must address the following. Check the appropriate boxes for those items on which specific action has been taken:

- ☐ Provide computers linked to an administrative section for maintaining student work-study coordination data.
- ☐ Provide computers for maintaining financial and administrative records of cooperative relationships for student learning, such as house building or renovation.

The teacher-focused technology issues described on page 45 above apply. The following issues should also be addressed and checked when specific action has been taken.

- ☐ Provide computers for competency-based instruction for students and instruction.
- ☐ Provide computers for inventory maintenance of materials, supplies and equipment.

☐ Provide computers for maintaining student progress, completion and placement data.

Please refer also to the following chapters: Administration, The Library Media Center, and Instructional Support.

The suggestions and recommendations for THE GENERIC CLASSROOM section above apply. In addition, address the following:

- Provide teachers with places for multi-media support of instruction. One solution is to provide each classroom and lab with a cart-based portable computer station, complete with a projection system or hookup to the classroom's TV receivers and printer, paper tray, laser disk player, modem, and a VCR. The power cord should reach the nearest power source (on a dedicated circuit) without extensions.

- Provide LMC classroom access to hypermedia and curriculum material. This may require an increase in LMC workstations provided.
- Provide dial retrieval and/or LMC classroom access to video programs.

- Provide access to remote locations such as career and technology centers, the Curriculum Center at the University of Maryland, and other schools and colleges.

- Provide a locked storage area for software and electronic hardware. This area can be part of LMC storage or located in the career and technology instructional area. Reduce the amount of airborne particulate matter where magnetic tapes, disks and dust-sensitive equipment are stored. Consider filters in air handling ducts and maintaining positive air pressure in the space. Please refer to section "Climate Control" on page 28.

- A business education lab should be equipped with one computer per student. The number of computers should be sufficient to accomodate the maximum class size. Provide one printer per three computers for word processing, one printer per five computers for other work.

- When the school's art curriculum calls for a graphic arts lab, this can also serve the technology education curriculum.

- In select classrooms and labs, including agriculture business, the teacher work station and student work stations should be networked. For a description on work stations, please refer to Appendix C.

- Consider revamping home economics laboratories into multi-purpose labs to facilitate integrated learning.

- Select classrooms and labs should be provided with outlets for a wall-mounted TV and a dedicated line for the teacher's telephone and modem.

- Provide a minimum of 10 multiple workstations per lab; include interactive technology.

- Locate classrooms for ready access for adult education and training programs during other than regular school hours.

ELECTRICAL POWER: Provide activity areas with required power, dedicated circuits and cable for specialized electronic hardware and related software.
Provide power outlets in sufficient quantity and of the right type (i.e., explosion proof, three phase) in all labs. Include bus bars and retractable sliding drop cords and master cut-off switches. The outlets, bus bars, and cords should not be on dedicated circuits for electronic technology.

ELECTRONICS: All computers should have modems or modem capability. Provide dedicated circuits and standardize on a 2400 BAUD rate and Hayes-compatibility.

Provide CAD (Computer-aided design) equipment in drafting, machine tooling labs. Provide one computer per person. Adjustable shelves for keyboards are recommended.

Provide a TV distribution system for classrooms, labs, and instructors' offices. Provide a closed circuit TV surveillance system.

LIGHTING: The correct selection and placement of lighting fixtures in an activity area housing CAD systems is of utmost importance. Designs displayed on CAD system monitors are above average in complexity of detail and must not be obscured by glare.

FINISHES: Computer and CAD users will shift their eyes from documents on work station surfaces to monitor screens. Therefore, the finishes and coatings on walls, ceilings, floors, and furnishings must be chosen to be within a moderate range of contrast and to be glare-free. Acceptable reflectance values, specified by an experienced illumination system designer, are recommended.

CLIMATE CONTROL: Consider maintaining areas that house computer workstations with positive air pressure. Provide well-sealed openings for a dust-free environment. Refer also to section "Climate Control" on page 28.

Provide special exhaust systems to remove chemically or particle-contaminated air from labs and darkrooms.

ACOUSTICS: Provide acoustic wall and ceiling surface treatments that serve to achieve acceptable dbA ratings. Consider installing acoustic baffles in noisy areas. For permissible noise exposures in labs that generate noise, please consult the Code of Federal Regulations, Title 29, Part 1910.95, Occupational noise exposure, latest revision.

ART

Be prepared to accommodate computer art, i.e., computer-aided design, graphics and digitized photography for grades 6 - 12. A graphic arts laboratory, to be shared with technology education, may therefore be advisable. Consider the following:

- At least one computer equipped with a special monitor and video board and which is capable of supporting sophisticated graphics software.
- Laser printers capable of color printing. Consider a digitizer and provide a 2400 BAUD rate Hayes compatible modem.
- If a graphic arts laboratory cannot be provided, it is essential to locate all electronic technology equipment in a protected area, free from dust and away from water and heat. Provide dust covers for all equipment, including keyboards.

MUSIC

The music classrooom must be prepared to accomodate computer-aided music, instructional and sound producing systems. This may require specific areas and more space. Classroom design must minimize sound transmission to adjacent spaces. Locate away from instruction and support areas that require a quiet environment. The layout and design of music classrooms should minimize the impact of sound so that teachers are able to monitor small group activities while conducting class activities. Consider the following:

- Electronic keyboard labs and synthesizers for the middle and high school years.
- Computer-aided systems with sound boards for all levels. Midi-interface is essential.
- Installation of high-quality stereo systems with the capability to play CDs and DATs (digital audio tapes).
- Microphones in all music classrooms.

PHYSICAL EDUCATION

Physical education programs that include electronic technology are becoming a standard way for students to receive information and for teachers to instruct them in fitness and other programs. The technology must aid in the teacher's performance of administrative duties that include recording fitness scores, performance tests, and grading. The teacher is also responsible for maintaining group records and reports. With regard to teacher-focused issues, electronic technology should be employed to address those issues described under the chapter "Instruction" above. With regard to student-focused issues, most of those described under "Instruction" also apply.

The following electronic technology-related issues must also be addressed. Check the boxes of the following list when specific action has been taken on each item.

☐ An intercom system in all physical education teaching stations and locker rooms should be connected to the main administrative offices and health suites. Such a system should be a key-controlled secure system, and is primarily required for emergencies.

☐ One or more teaching stations should be provided to students for access to computers capable of interactive video instruction.

☐ Fitness training technology (Nautilus equipment, stationary bikes, etc.) and technology for physical therapy should be considered for appropriate programs.

☐ In those physical education teaching stations where videotaping of students is likely to occur, the quality and ambient lighting levels must allow the production of videotapes of a correct color. Videotaping students can take place during skill practice in various sports settings for later review and analysis by the learner and the teacher.

☐ Where simultaneous teaching in two or more teaching stations occurs, such stations must be provided with visual access. Where windows are provided, they should be equipped with nonbreakable glass.

☐ Provide electrical outlets in locations that are readily accessible by power cords on portable carts that house such equipment as computer, VCR, laser disk player, tape player and other, sound systems.

SCIENCE

Before the introduction of electronic technology, demonstrations and hands-on science instruction depended on the use of charts, maps, and films, and through actual experiments and tests.

The introduction of VCRs, computers, and interactive TV has brought a whole new array of techniques to complement traditional methods of teaching. This has a profound impact on the arrangement of the activity areas to best meet the objectives of both learner and teacher. Computer application software for word processing, database, and spreadsheets are required.

- Provide each teacher with a command center that consists of a demonstration table and a workstation which may or may not be portable. The command center must allow for multi-media support of instruction and should therefore include a computer station complete with a projection system or hookup to the classroom's TV receivers and printer, paper tray, laser disk player, modem, and a VCR. The power cord should reach the nearest power source (on a dedicated circuit) without extensions.
- Provide each student with access to a computer-equipped student technology workstation. Provide one workstation per a maximum of four students. Each workstation must be sized to accomodate adjacent student experiments which may require the use of water, gas, and electrical power, as well as writing needs.
- Computers should not be located where student experiments with water and gas take place. The computer-equipped portion of the workstation may or may not be mobile.
- A science lab should accomodate the use of camcorders mounted on a copying stand. Such a device would serve to project and record visuals and demonstrations that are difficult to prepare and last only seconds. Recorded, they can be viewed again, repeatedly. A hookup to TV receivers is desirable.
- Provide a (ceiling-track mounted) pull-down screen. Because computer images projected on walls lack clarity, use a 4×5 ft. clear, white, and absolutely smooth wall surface only as a last resort.

Many innovative science programs in all grade levels require access to national networks such as "KIDSNET," "Weather Satellite Data," and others. Therefore, telecommunication capabilities are important.

With the aid of strategically placed electronic monitoring devices during construction, the school building itself can become a science laboratory. Consider the following (to name a few):

- Install a large observation window on an exterior or interior wall to the school's heating plant.
- Color code the hot, cold and chilled water lines in visible areas throughout the building, including the heating plant.
- Locate the monitoring diagrams for the HVAC and power systems where instruction about them can take place.
- Build temperature and moisture sensors into the building structure to monitor the soil under footings and by walls at grade level, in exterior wall cavities, under roof decks, etc.
- Locate barometric pressure gauges, anemometers and weathervanes in appropriate places with digital readouts in suitable instructional areas.
- Probes measuring sound travel through building materials of various densities can also be installed during construction.

Please refer also to the "Generic Classroom" chapter, page 47. In addition to the building components below, please refer also to the components listed in the "Computer Lab" chapter, page 59, and the various parts in Section II -- Building Components.

> ELECTRICAL POWER: Provide outlets for connecting computers to the building-wide network. Provide outlets for printers and other peripherals. Group the outlets for computers, standard power, TV, and a modular telephone jack convenient to the teacher's command center. A minimum of four outlets per student workstation is recommended; locate outlets in the floor or at counter height, depending on the workstation configurations. Outlets on dedicated circuits should be color coordinated or otherwise clearly marked. Provide in-floor conduits and floor outlets as required.

ELECTRONICS: Provide in-floor conduits for cabling and twisted-pair wiring. TV outlets and telephone jacks should be reachable from the teacher's command center and mini-labs. Provide dedicated lines for telephones and modems and standardize on a 2400 minimum BAUD rate and Hayes compatibility. Group together the various outlets and jacks wherever possible.

Provide shared printer access at each work station. A minimum of four printers per science lab is desirable. Each workstation must also be provided for hookups to a classroom TV monitor, capable of transmitting to it from such interface equipment as thermistors, microscopes and photoreceptors that are used in experiments.

The teacher and student workstations should be networked and capable of running different application software simultaneously. The teacher station and administrative offices should be networked.

LIGHTING: Describe any special task lighting requirements. Uniform, ambient lighting is desirable. Painting a matte finish on the walls behind the monitors helps to reduce glare, and chosing a darker color which complements the monitor screen helps to reduce eye strain by reducing the contrast between monitor and wall.

Indirect lighting, obtainable through stem-mounted uplights is desirable. Daylight must be controllable by means of shades, blinds or drapes. For more on lighting and lighting control, please refer to Section II - Building Components.

CLIMATE CONTROL: Thermostatically controlled air conditioning shall be provided for year-round use. Refer to section "Climate Control," page 28.

PLUMBING/GAS: Water and gas must be located beyond reach of any person operating electronic equipment.

SECURITY: All science labs should be included in the security system.

FURNITURE AND EQUIPMENT: Provide markerboards and "liquid chalk" markers in lieu of chalkboards. Computers and other electronic equipment can be rendered inoperable by chalk dust.

THE LIBRARY MEDIA CENTER

The school library media program is an integral part of the instructional process, providing access to a wide variety of information sources as well as teaching students and staff how to use them. Adequate space allocations for the management of the library media program, the instruction of students and staff, and the utilization and storage of materials and equipment are outlined in Appendix 3 of Standards for School Library Media Programs in Maryland, a publication of the Maryland State Department of Education. Incorporating electronic technology into these spaces not only enhances the services to students and staff by delivering resources in an efficient and timely manner, but it also improves patrons' skills in the successful use of new technology.

Incorporating technology, the school library media center thereby can provide the following:

LIBRARY AUTOMATION

- Electronic catalogs linked to selected university or public libraries for immediate information on the availability and location of materials
- An automated circulation system providing bibliographies, acquisitions, overdues, statistical data and an on-line catalog with up-to-date information on the center's holdings
- Dedicated phone lines and computer terminals for electronic information retrieval
- Computer terminals with laser disk players and on-line access to reference information and holdings of other libraries; hookups to printers and other peripherals should be provided
- Hypermedia capability with a sufficient number of workstations to accomodate all students
- 24-hour copy protected (as required) download capability of licensed software into students' modem-equipped home computers through a

series of modem ports. Standardize modems on a 2400 minimum BAUD rate and on Hayes-compatibility

- An LAN to provide call capability from all labs, classrooms, teaching stations, and administrative offices

- Stand-alone personal computers for general purpose use, computer-assisted instruction and word processing, with printer access from each work station

RESOURCE SERVICES

- A detection system that protects the current investment in materials

- Provide a locked storage area for software and electronic hardware. Reduce the amount of airborne particulate matter where magnetic tapes, disks and dust-sensitive equipment are stored. Filters in air handling ducts and maintaining positive air pressure in the space are options. Refer to section "Climate Control" on page 28.

- Copy and FAX machines for sharing resources with other libraries

- The "head-end" of the school's TV distribution system. It provides delivery of video-based information throughout the building by means of a closed circuit television system. The head-end should be located in its own enclosed space or a wire closet

- Access to commercial and instructional TV over cable, twisted pair or regular broadcast that permits specific programs to be piped on request into classrooms

- An electronic bulletin board that identifies available resources and resource services and allows schoolwide information exchange

INSTRUCTIONAL SUPPORT

COMPUTER CLUSTERS

Refer also to the sub-chapter "The Generic Classroom," page 47 in the chapter on "Instruction" above. Clusters help to provide small group instruction and give students the freedom to explore. Clusters or mini-labs are best located within or adjacent to the standard classroom setting. The inevitable trend is toward more classroom computers. While a cluster of six computers may be considered a minimum today, in the near future eight to ten or more may be the only acceptable minimum.

Clusters partitioned off with glass panels provide visual access for teachers into one or more clusters.

Clusters may be shared between classrooms or departments and may be networked. Their capacities will vary. Some are used primarily for word processing, others need access to databases or must have videodisk capability. Each cluster must be planned individually, depending on variables.

The number of printers required to support a given number of computers is determined by the usage and speed of the printers and whether or not they are networked. Clusters or mini-labs devoted primarily to word processing require more printers.

It is recommended that edspec planners consult with vendors to determine spatial needs for equipment in clusters or mini-labs before determining over-all area requirements. For a generic design without bias, the services of the consulting archcitect's space planner may be preferred.

Activity areas for which computers must be considered include: the corrective reading classroom; the volunteers' room, if provided; and the speech room which, in addition to computers, should be equipped with microphones and speakers on the outside for parent use when observing their youngsters.

THE COMPUTER LAB

The area known as the computer lab warrants more than usual flexibility. Instructional methods are evolving and throughout the school computers are becoming more numerous and portable. Locating the computer lab adjacent to the library media center might, therefore, be advisable.

The configuration of a computer lab is determined by whether it is designed to be a teacher-directed activity area, a student-directed activity area, or a combination of the two. It is assumed that the teacher work station and the student work stations are networked.

Teacher-directed labs may be configured in a conventional classroom seating arrangement, but flexibility must be maintained. Student-directed labs may have computers lined along the perimeter walls of the room with work tables in the middle. A combination teacher-directed and student-directed lab may have "islands" of computers or "fingers" throughout the room. Avoid internal lab traffic around computer work stations.

Strive for sight lines that allow a teacher to observe all monitors from one place in the room.

Provide space in the computer lab for students doing paper work. Up to one-half of the class can be expected to engage in some paper activity at any one time. Students can be expected to do short demonstrations at computer stations, combining this activity with written work.

Provide a dedicated line for a telephone and modem at the teacher's command center. Standardize modems on a 2400 minimum BAUD rate and on Hayes-compatibility. Consider multi-media access over a network for the computer lab.

Regarding the building components below, please refer also to the various components in Section II -- Building Components.

> ELECTRICAL POWER: The file server and associated printer should be wired to a dedicated circuit. Provide a single switching location from where all computers can be turned off. A rule of thumb is to provide a switched 20 Amp dedicated circuit for every five computers. This is based on the amount of power draw required by disk drives. Consider using surge devices directly on the circuit box. Decide in advance, wherever possible, on the number of computers required and the preferred direction of future expansion. For further descriptions on power please refer to section "Electrical Power" beginning on page 23.

Protect from overloads and brown-outs. Allow conduits for future new technologies.

Consider including in the edspecs a conceptual cabling plan or description (in the form of a ring, straight line or fork, for example) for the floor.

ELECTRONICS: One computer per student is desirable. Provide one printer for every five computers or fraction thereof as a rule of thumb. The actual number of printers required to support a given number of computers is determined by the usage and speed of the printers and whether or not they are networked. Labs devoted primarily to word processing require more printers.

Provide space for the file server in an accesible but out-of-the-way location in the lab. If the lab has multi-media access, provide countertop space near the file server for a CD ROM player and a videodisk player.

LIGHTING: Ambient lighting must be controlled to avoid glare on monitor screens. Painting the walls behind the monitors a matte finish helps to reduce glare. Chosing a darker color that compliments the monitor screen helps to reduce eye strain by minimizing the contrast between monitor and wall.

Indirect lighting, obtainable through stem-mounted uplights and parabolic eggcrates, is desirable. Daylight must be controllable by means of shades, blinds or drapes. For more on lighting and lighting control, please refer to Section II -- Building Components.

ACOUSTICS: Protect from sound transmission from noisy areas. Locate away from athletic, eating, music or shop areas. Refer to Appendix C, section "Peripherals" for printer sound enclosures.

CLIMATE CONTROL: Electronic equipment generates heat. Provide air conditioning with thermostatic control for year-round use. Particular attention must be paid to the placement of heating units, fans, and ceiling diffusers. They must not be located over or by the computers because of the dust factor. Please refer to section "Climate Control" on page 28.

SECURITY: Locate in areas open to the public during non-school hours and provide access to restroom facilities. Locate away from vulnerable windows. Second floor locations are desirable, where available.

Provide electronic access control, a surveillance system or door locks with deadbolts, where permitted, or metal flanges covering the latchbolt and strike. Any glass vision panels in doors to the lab should be security-protected.

FURNITURE AND EQUIPMENT: Provide static-free floor surfaces. Vinyl composition tile is recommended over static-free carpet. Provide dustless marker boards.

Provide a (ceiling-track mounted) pull-down screen. Because computer images projected on walls lack clarity, use a 4×5 ft. clear, white, and absolutely smooth wall surface only as a last resort.

Provide a fixed or cart-based computer station for the teacher. It should include a projection system, printer, paper tray, laser disk player, and a VCR. Dedicated circuit outlets must be color coded or otherwise marked.

Provide a lockable storage cabinet for manuals for all programs, software, printing paper including hanging files for printouts, blank disks, copies of various programs for student use, miscellaneous paper, and materials for cleaning computers and monitor screens.

Consider providing fireproof storage for backups and program disks. Fireproof storage in the administrative area may be enlarged to house these items.

Provide display area for computer and computer-related magazines, etc.

Labs should be designed for easy cleaning. Cabling should be concealed and covered. Dust covers for VDTs, keyboards, CPUs, printers, etc. are recommended.

THE INTERACTIVE TV CLASSROOM

Distance learning is an instructional technique which links students in several sites simultaneously via two-way television. This demands an instructional methodology sufficiently different to warrant a dedicated TV classroom that should not be used for any other activities.

Distance-learning classrooms must be designed to accomodate a wider, deeper range of student skills than a "local" site can offer; they should offer the students greater opportunities to interact than traditional single-classroom settings.

Successful distance instruction requires new classroom management strategies and the ability to use technology. Teachers should project an intellectually and emotionally attractive "telepresence"; building virtual communities of learners is also vital.

The equipment installed in this classroom--TV cameras, large screen monitors, microphones and mixers, modulators and fax machines--require careful placement and protection from unauthorized use. The equipment must be ready for class every day and should, therefore, never be removed or used for other purposes. It should be permanently and unobtrusively installed allowing clear paths without obstructing cables for ease of movement in the room.

There are several possible configurations for two-way interactive TV classrooms. Some require more equipment than others, some more staffing. The decision on equipping the facility should be made at the design stage because its configuration should be based upon the teaching methodology, not the other way around. Please refer to page 85 for one suggested configuration.

The interactive TV classroom lends itself well for teleconferencing. If such use is contemplated, it must be designed to accommodate this activity.

Each site should be capable of being both the sending and teaching location and therefore should be equipped similarly. Consider the following factors:

- Different camera techniques are possible. While remote-controlled equipment is available, the preferred way is to employ an aide capable of operating equipment while monitoring classes in the remote schools. A low-cost option uses a single aide-operated camera. An option using a two-camera sending system has the aide operating a movable camera while the other one is fixed on the teacher, the class, or on instructional material. Either the aide or the teacher controls switching between cameras. This depends on the placement of the switching equipment. In the receiving schools the cameras are focused on the class and operated by aides; when a receiving-school class becomes the sending location with a teacher present, a second camera must be available.

- Teachers use VCRs and/or videodisk players, or an auxiliary computer network using telephone lines to transmit pictures and other data. The equipment configuration should reflect these needs and specify a switcher capable of handling multiple inputs. A computer connected to an overhead projector and an LCD display tablet, and a camcorder mounted on a copying stand, or a fixed overhead one pointing down at the teacher's desk, are recommended for transmitting demonstrations and images from notes, books, and papers.

- A fax machine may be the most economical method for sharing assignments, homework, and examinations between sites. Provide a dedicated telephone line for this purpose. Alternatively, the computer at the sending site can be used to transmit them to printers at the receiving sites.

- One or two very large screen monitors (47" - 60"), permanently placed in the front of the room, allow the students to see and hear the teacher, students and visuals in other classes. A large monitor in the back allows the teacher to see the students in all receiving and sending locations. A quad-split technique is an effective way to show all remote locations on one screen. The teacher, however, should be seen alone on one screen.

- White markerboards and dark "liquid chalk" markers in lieu of chalkboards are recommended.

- The audio system must be sensitive enough to pick up all students' voices from their normal positions while filtering out excessive ambient noise. Providing the teacher with a wireless lavalier microphone permits freedom of movement; classroom microphones are fixed to the students' tables. Care must be taken to avoid feedback of the sound from TV speakers.

- Locate the room near the library media center for easy access to AV resources. Locate away from normally noisy areas such as the cafeteria, gym, music, or shop rooms.

- Provide appropriate paths for the floor camera. Clear shots must be obtained of the teacher, students, and displays. Make sure that sight lines in the receiving locations are appropriate for students to observe the teacher and the displays.

- The classroom size and configuration must be appropriate for the number of students. It must also accomodate the mobility of the teacher and the camera.

In addition to the building components described on the next page, please refer also to the various components in Section II -- Building Components.

ELECTRICAL POWER: Provide noise-free, grounded power circuits. An adequate amount of power is essential. The use of broadcast-level cameras by professional crews may cause TV screens to flicker if the power is inadequate. For further discussions on power, please refer to section "Electrical Power," page 23.

ELECTRONICS: Wireless miking is desirable. This requires a transmitter, receiver, batteries, and FCC frequency allocation. The teacher should be miked separately. Group the seating for students in ways best for microphones.

Provide a dedicated line for telephone, modem, fax machine.

TV equipment should be attached to heavy-duty cable. RG-6 is the minimum recommended. Run cable in the ceiling or in moulding below the ceiling and on walls. Provide cable covers for floor-run cables. Cable drops at each end of the classroom are desirable.

Control of the PA system, including any speakers, must be provided in the interactive classroom.

LIGHTING: Daylight must be controllable by means of blinds or drapes. Glare on TV screens must be avoided. Uniform, ambient light is essential; stem lighting and upgraded fluorescent fixtures with parabolic eggcrates and color corrected tubes are recommended. Staggered light fixtures are desirable. Cameras do not require special lighting, but they cannot shoot into light.

Illuminate walls evenly. Special attention must be given to reflected color. Camera shots should show students against contrasting backgrounds: dark complexions and clothing should be placed in front of light backgrounds and vice versa.

ACOUSTICS: Block walls, windows, vinyl floors, and markerboards create a "live" room. Deaden walls with carpeting or acoustic ceiling tiles, windows with drapes, floors with carpeting suitable for rolling a TV camera on its stand. Please refer to Appendix C, section "Peripherals" for printer sound enclosures.

Block sound vibration and diffuser noise from climate control equipment. Configuring and sizing of ductwork must take acoustics into account.

CLIMATE CONTROL: Provide temperature and climate control for year-round use. Electronic equipment generates heat. HVAC equipment, including motors, air ducts and diffusers, must be designed with sound transmission levels acceptable for broadcasting from and to dedicated rooms. Sound baffles should be built into supply air ducts, and air velocities kept low to preclude diffuser noise. Please refer to the section "Climate Control" on page 28.

SECURITY: Locate in areas open to the public during non-school hours and provide access to restroom facilities. Locate away from vulnerable windows. Second floor locations are desirable, where available.

Provide electronic access control, a surveillance system or door locks with deadbolts, where permitted, or metal flanges covering the latchbolt and strike. Any glass vision panels in doors must be security-protected.

A TV PRODUCTION FACILITY

A CCTV studio complex provides equipment, staff, and resources to produce closed-circuit television programs.

Explore leasing cable company facilities before designing a TV studio space in the school. A TV production facility must be justified by appropriate school-based programs offered to the students.

Facilities should be designed to a particular level of skill development in students and will, therefore, vary in size. A high school offering courses dedicated to TV production may require a control room, editing space, and a post-production lab in addition to a TV studio. The total area ranges between 1000 and 13000 sf. A middle school facility can be the size of a generous classroom. The elementary school studio can be even simpler and requires much less space; which can be shared.

The development of the hand-held Super VHS camera has reduced the need for many costly accessories. The VHS casette and microphone are built-in; playback through the camera, a hook-up to a TV receiver, editing and re-recording onto another machine are all possible with a single piece of equipment.

Acoustical and lighting design must be coordinated and in place prior to the installation of production equipment. Note that lighting demand may require an increase in the electrical supply.

When planning a TV production facility check the boxes of the following list after specific action has been taken on each item.

- ☐ The proper fit of the electronic technology to the instructional programs must be determined.
- ☐ Determine the level of student and staff use to establish the need for equipment supporting that use.

☐ The preferred location of a TV production facility, when part of the library media center function, is adjacent to the LMC. Thus (audio)taping facilities and the "head-end" can be shared. Locate away from noisy areas.

☐ Provide a workable arrangement of equipment that includes easy access and operation for student and staff. Provide an area suitable for staging any activity that shall be produced.

☐ The set area should be sufficiently flexible to accommodate a variety of individual props and materials for desired settings.

☐ Provide a closed-circuit network to classrooms, gym, auditorium, cafeteria, the library media center and conference rooms.

In addition to the building components below, please refer also to the various components in Section II -- Building Components.

ELECTRICAL POWER and ELECTRONICS: The recommendations for the section Interactive TV Classroom beginning on page 63 apply.

LIGHTING: Exclusion of daylight and control of artificial light is a major requirement. Determine if ceiling mounted lighting bars and/or tripod mounting lighting kits are preferred. The lighting demand of a large TV production facility may require an increase in the electric supply (amperage).

CLIMATE CONTROL: Provide climate control for year-round use. Lights generate heat and must be factored in the system design. HVAC equipment, including motors, air ducts and diffusers, must be designed with sound transmission levels acceptable for broadcasting from the studio. Sound baffles should be built into supply air ducts, and air velocities kept low to preclude diffuser noise. Please refer to the section "Climate Control" on page 28.

ACOUSTICS: Ceilings and walls must incorporate sound-deadening materials that serve to absorb noise from adjacent areas, isolate reflected sounds off nearby structures or which reverberate within the room. A cyclorama track and curtain may be desirable.

SECURITY: Provide electronic access control, a surveillance system, or door locks with deadbolts, where permitted, or metal flanges covering the latchbolt and strike. Glass vision panels in doors to the lab should be security-protected.

ELECTRONIC COMMUNICATIONS SYSTEMS PLANNING CRITERIA

In keeping with the purpose stated in Section I those charged with the responsibility for planning a specific school facility must plan from the onset a facility that provides and resolves the following:

☐ Determine what shall be sufficient and appropriate space and security for the maintenance and storage of electronic communications equipment.

☐ Specify those procedures that are necessary for handling equipment and software, i.e, inventory, maintenance, and storage.

☐ Determine which computer-equipped activity areas will be used for computer lab purposes and which will not; determine which of these areas will be accessible before or after regular school use.

☐ Determine the potential and future number of networked and stand-alone work stations that each fully utilized computer-equipped activity area will have.

☐ Provide the rationale that determines the configuration of work stations of a computer-equipped activity area (perimeter, finger plan or other).

☐ Determine the number of students who will team on computers, if any; determine the size of teams and identify group projects and their size.

☐ Determine how computer-equipped activity areas will be staffed for monitoring and wether or not monitoring will occur from an adjacent area.

☐ Provide secure and accessible emergency shut-off of file servers and other electronic hardware.

☐ Provide one or more Data Security Areas (vaulting for software and magnetic tape back-ups, etc.) in appropriate locations throughout the school.

☐ Specify which computers are to be connected to the library for information access.

☐ Provide a plan for dealing with power failure, brown-outs, and power surges.

☐ Provide the methodology and means for protecting copyrighted software.

APPENDIX B

LOCAL AREA NETWORKS TECHNICAL OVERVIEW

SOFTWARE ACCESS: a method or protocol that is used to control entry and retrieval of data in a network.

CSMA/CD: carrier sensed, multiple access/collision detection is a method of network access that prevents interference with messages that are on line.

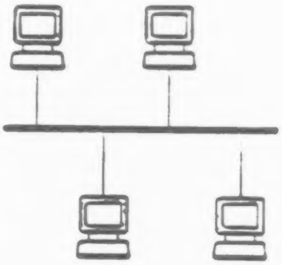
CIRCUIT SWITCHING: a method of connecting both sending and receiving channels.

POLLING: requests input from each network device as to its message status. It can be described as a centralized, controlled access design.

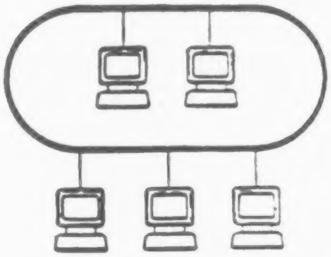
TOKEN PASSING: an access method that sends tokens to each network device for its message status. It can be described as a distributed, controlled access design.

TOPOLOGY: the physical arrangement of network devices. Topologies may be connected in various combinations.

BUS: a network design in which all devices are connected to a common communications path that allows each device to send addressed signals along the path or "bus" in both directions. Each device on the bus waits for its addressed signal to process. Control can be centralized or distributed throughout the network.

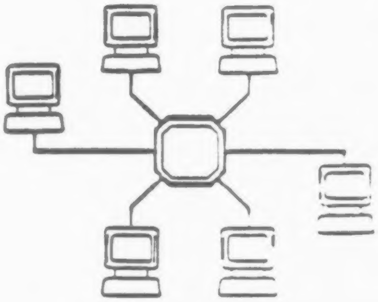


Advantages:	Provides the most direct cabling route that uses less cable.
Disadvantages:	Requires control capability in both directions for messages sent simultaneously. Cable breaks are not easy to find.



RING: a design that is configured in a logical circle with messages traveling in one direction along the communications path. A device sends its addressed messages around the ring. Each device listens for its address and when the device recognizes it, it accepts the message.

Advantages:	Communication control is simplified. Greater network distance. Cable breaks are easy to locate.
Disadvantages:	It is difficult to accommodate facility changes

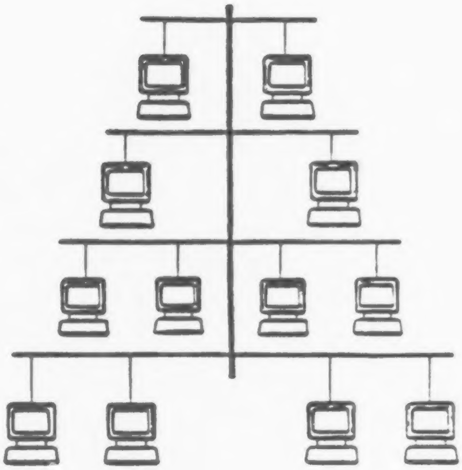


STAR: a network design that connects each device to a central controller. The connections allow for signals to be transmitted in both directions and all messages are sent from the transmitting device through the controller, to the receiving device. The central controller manages and controls all communications. Example., the telephone system/PB.

Advantages:	Cabling is easy to modify when facility changes are required. Defective devices are easy to locate and isolate
Disadvantages:	Uses the most cable. Failure of the central controller makes the entire network inoperative.

TREE: a network design much similar to the bus topology. Extending from the common communications path are branches that connect each device to the network. Its communications parameters are the same as the bus design. Example, a CATV system.

Advantages and disadvantages are similar to those for a bus design.



CABLING: the wires of transmission line used to connect computer devices together in a network. Most cabling consists of shielded copper wire or fiber optic cable.

SHIELDED COPPER WIRE

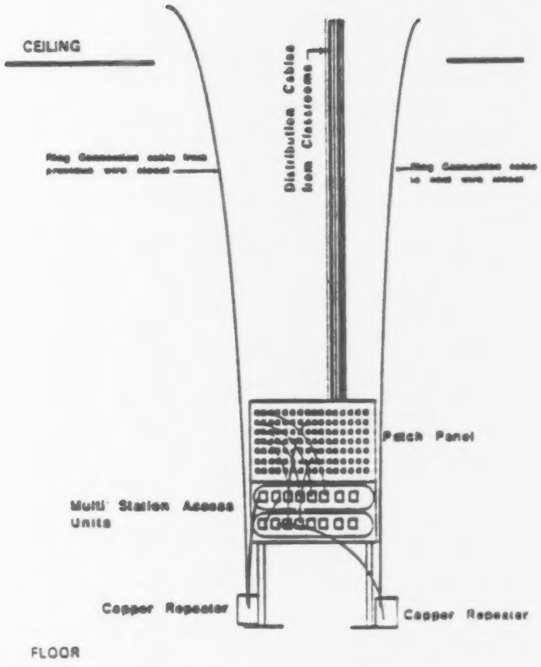
TWISTED PAIR: two conductor cable covered by an outer wire shield. It is economical, easy to use, virtually free from electrical interference and cross talk. Twisted pair cable can be used at transmission speeds of up to 10 MB/S. Line amplification is required for long-distances.

COAXIAL CABLE: single conductor cable with a copper shield provides greater bandwidth than twisted pair. Used also in:

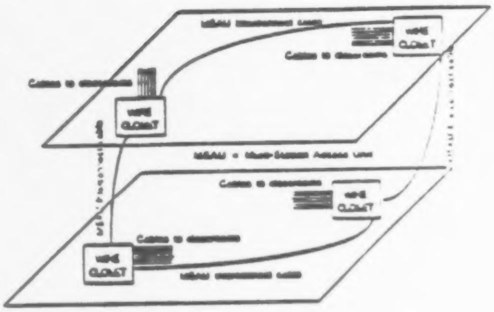
CATV APPLICATIQNS: Coaxial cable can be used at transmission speeds of 350 MB/S. Usually larger in diameter than fiber optic cable, not as flexible. Line loss is minimized with coaxial cable.

FIBER OPTIC CABLE

Used for very high speed, high capacity systems. Fiber optic cable is not susceptible to noise or electrical interference. It is designed with a glass inner core and a different glass outer layer, both wrapped in a vinyl sheath. Multiple strands are available for bi-directional applications. It is cheaper than coaxial, signals can travel farther distances than over copper wire, but fiber optic cable can be more expensive to connect to existing equipment and is more difficult to install.

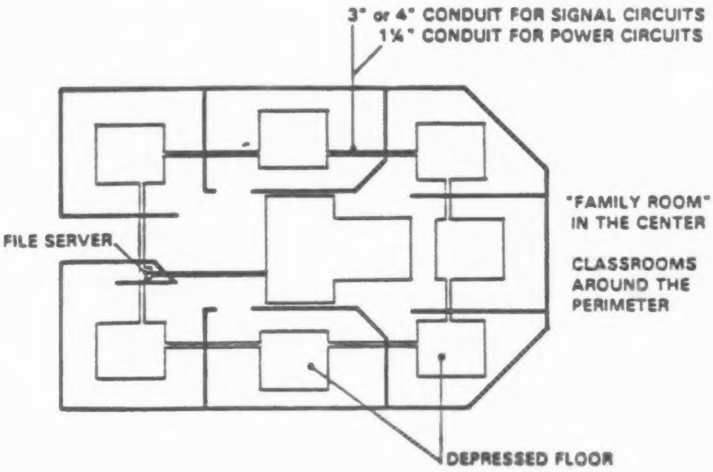

CEILING
Distribution Cables from Classrooms
Ring Connection cable from previous wire closet
Ring Connection cable to next wire closet
Patch Panel
Multi Station Access Units
Copper Repeater
Copper Repeater
FLOOR

A WIRING-CLOSET DETAIL
FOR A RING-DESIGN NETWORK


WIRE CLOSET
WIRE CLOSET
WIRE CLOSET
WIRE CLOSET
MSAU = Multi-Station Access Unit

A RING-DESIGN WIRING
SCHEME FOR TWO FLOORS

The Belle Valley elementary school in the Mill Creek Township School District, Pennsylvania provides both classroom integration of computers and complete flexibility in the placement of furniture and equipment.

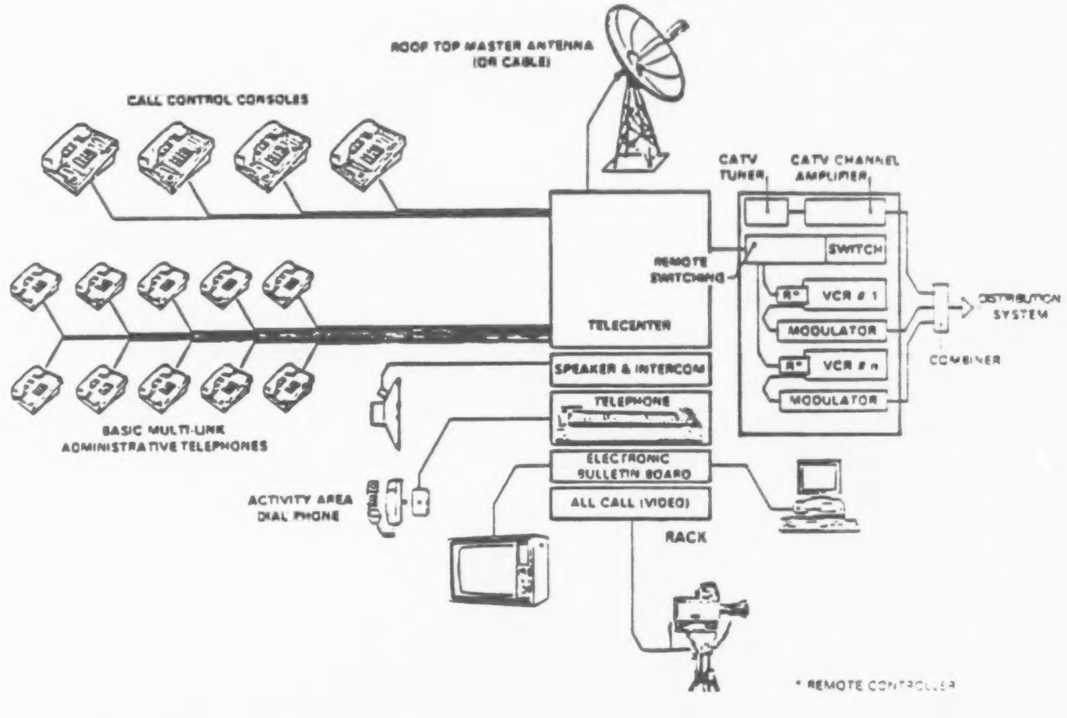

3" or 4" CONDUIT FOR SIGNAL CIRCUITS
1¼" CONDUIT FOR POWER CIRCUITS
FILE SERVER
"FAMILY ROOM" IN THE CENTER
CLASSROOMS AROUND THE PERIMETER
DEPRESSED FLOOR

DRAWING NOT TO SCALE

PVC cable and wire conduits connect depressed floor areas in the center of classrooms. In-the-floor outlets are provided for power (dedicated and regular) and signal circuits. Carpeted raised floorplates cover the 8 inch depressed floor areas.

Note that circuits should be housed in separate conduits where magnetic fields surrounding power wires may disturb signal transmission along signal wires. Fiber optic cable, however, is immune to electrical interference. Proper grounding and shielding of all copper (metal) wiring shall be provided.

A TELEPHONE CENTER AND CATV/VCR DIAL RETRIEVAL LAYOUT


ROOF TOP MASTER ANTENNA (OR CABLE)
CALL CONTROL CONSOLES
CATV TUNER
CATV CHANNEL AMPLIFIER
REMOTE SWITCHING
SWITCH
R*
VCR # 1
MODULATOR
R*
VCR # n
MODULATOR
DISTRIBUTION SYSTEM
COMBINER
TELECENTER
SPEAKER & INTERCOM
TELEPHONE
ELECTRONIC BULLETIN BOARD
ALL CALL (VIDEO)
RACK
BASIC MULTI-LINK ADMINISTRATIVE TELEPHONES
ACTIVITY AREA DIAL PHONE
* REMOTE CONTROLLER

COMPARISONS OF TRANSMISSION MEDIA - I

	Twisted Pair Wire	Baseband Coaxial Cable
Topologies supported	Bus, Ring, Star, Tree	Bus, Ring, Tree
Maximum number of nodes per network	Generally up to 1024	Generally up to 1024
Maximum distance	2 miles	6 miles
Type of signal	Single channel, unidirectional, analog or digital, depending on type of modulation used; half- or full-duplex	Single channel, bi-directional, digital half-duplex
Maximum bandwidth	Generally up to 1 Mbps	Generally up to 10 Mbps
Major advantages	Low cost May be existing plant; no rewiring needed; very easy to install	Low maintenance cost. Simple to install and tap
Major dis-advantages	High error rates at high speeds Limited bandwidth Low immunity to noise and cross-talk. Difficult to maintain and troubleshoot. Lacks physical ruggedness; requires conduits, trenches or ducts	Lower noise immunity than broadband; can be improved by the use of filters, special cable and other means Bandwidth can carry only about a 40% load to remain stable. Limited distance and topology. Conduit required for hostile environments Not highly secure

COMPARISONS OF TRANSMISSION MEDIA - II

	Broadband Coaxial Cable	Fiber Optic Cable
Topologies supported	Bus, Tree	Ring, Star, Tree
Maximum number of nodes per network	Up to about 25,000	Generally up to 1024
Maximum distance	31 miles	6 miles
Type of signal	Multi-channel, uni-directional, RF analog, half duplex. Full duplex can be achieved by using two channels	One single channel, uni-directional, half-duplex, signal-encoded light beam per fiber; multible fibers per cable; full-duplex can be achieved by using two fibers
Maximum bandwidth	Up to 400 MHz (aggregate total)	Up to 50 Mbps in 10 kilometer range: up to 10Gbps achieved in experimental tests
Major advantages	Supports voice, video and data applications simultaneously Better immunity to noise and interference than baseband. More flexible topology (branching tree). Rugged, durable equipment; requires no conduit. Tolerates 100% bandwidth loading. Uses off-the-shelf industry-standard CATV components	Supports voice, video and data applications simultaneously Immunity to noise, crosstalk and electrical interference. Very high Very high bandwidth. Highly secure. Low signal loss. Low weight/diameter. can be installed in small spaces. Durable under adverse temperature, chemical and radiation conditions
Major disadvantages	High maintenance cost. More difficult to install and tap than baseband. RF modems required at each user station. Modems are expensive and limit the user device's transmission rate	Very high cost, but declining. Requires skilled installation and maintenance personnel. Limited commercial availability. Taps not perfected. Currently limited to point-to-point connections

FUNCTIONAL AND SPACE REQUIREMENTS

This appendix serves as a planning tool and database. Its intended use is in connection with the development of Section III - Activity Areas. It aids the facility planner to determine the number of square feet necessary for an activity area to serve appropriately what it is designed to do.

All square foot areas (sf) are net. Unless noted otherwise, circulation space is not included with the item.

Electronic hardware requires the use of many wires and cables. In areas consisting of several work stations, a wire management plan developed prior to an installation contract is desirable.

Good wire management is reflected in work station desktops that provide channels, grommets (large finished holes in the top of work surfaces or backs of hatches) or casings (cut into, or attached to work surfaces allowing the wires to channel neatly to a given station). Wires are hidden from view and inaccessible to students.

WORK STATION -- K through 12

This is a generic computer work station in any instructional setting. The recommendations apply for a single work station in a lab setting or an individual one.

Width : To accommodate a micro computer or computer terminal; allow 22" - 28" plus 10" - 14" for hands, papers, reference materials, a mouse, joy stick; plus space for any necessary peripherals; a printer requires a minimum of 20" for instance. Provide elbow room.

Desktop : area
30" wide x 30"-34" [2] deep (6.25-7 sf.) for a single person, K - 6;
39" wide x 30"-34" [2] deep (7.5-8.5 sf.) for a single person, 6 - 12.
Depths include keyboard space and wire channels.

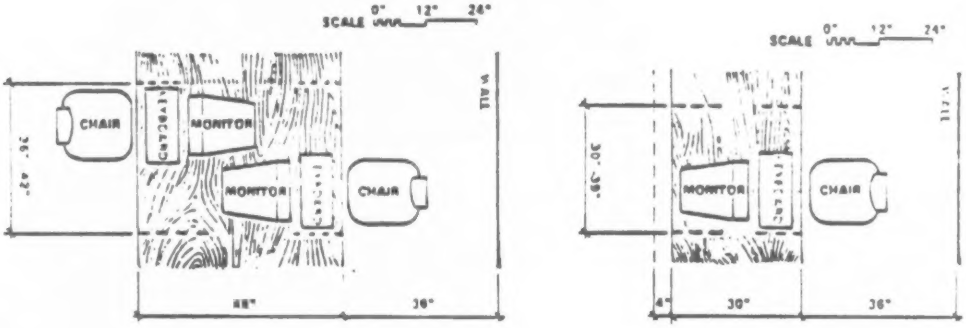
Where students team on computers, or if the presence of a seated teacher is required, increase width to 50".

Each student work station should have the capability of accepting a telephone and a modem.

Desktop : height
Ideally, adjustable from 23" to 29".
Fixed height desktops: 26" for K - 8 grade.
Fixed height desktops: 26" - 29" for 9 - 12 grade.

Recommended position of monitor: 15 degrees down from eye level to the center of the screen.

An adjustable desktop-wide keyboard shelf is desirable. Alternatively, consider providing an adjustable monitor arm.


SCALE 0" 12" 24"
CHAIR
KEYBOARD
MONITOR
MONITOR
KEYBOARD
CHAIR
WALL
36"-42"
48"
36"
SCALE 0" 12" 24"
30"-36"
MONITOR
KEYBOARD
CHAIR
WALL
4"
30"
36"

The continuous desktop on the left shows partially overlapping monitors. If back-to-back monitors are necessary, the desktop depth must be increased to a minimum of 60 inches. On the right is shown a single monitor of a bank of monitors facing in the same direction. Note the 4" wire space.

TYPICAL LAYOUTS FOR BANKS OF COMPUTER TERMINALS

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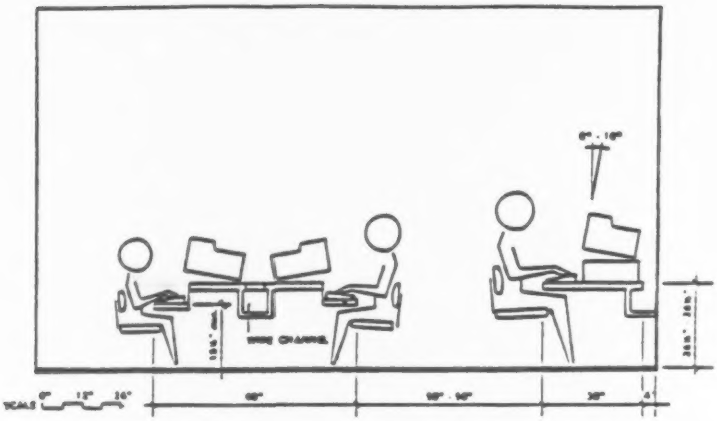
[2] For some larger model PC's a desktop depth of 34" may be necessary; consult your vendor



TYPICAL SEATING POSITIONS

Electrical : Supply of "clean" power to each work station is essential. Provide a minimum of 4-5 outlets per work station. Consider quad outlets in lieu of strips. Locate outlets in a manner that insures glare-free computer screens.

The light source for work stations should be indirect, reflected off the ceiling or wall.

Laser printers should be on a separate circuit from networked or stand-alone PCs.

General : It is recommended that dustcovers for computers, including keyboards, be used.

Provide a shelf or drawer under each work surface for K - 5.

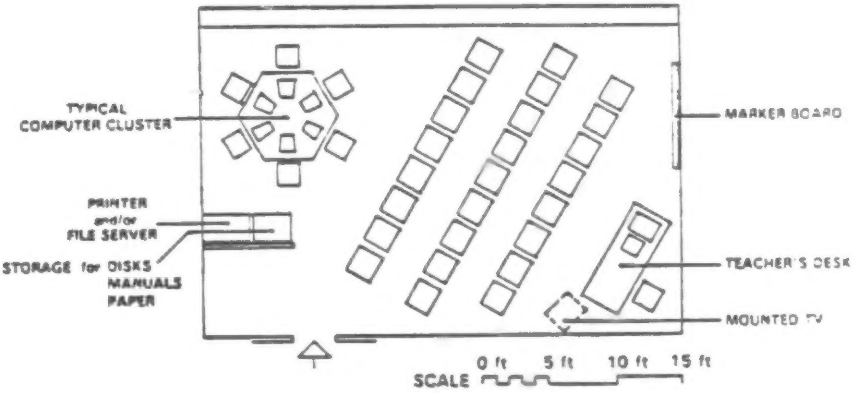
For high school and middle school students, provide a storage shelf for books, bookbags, etc. below the desktop or to the side of it. Shelf size: 36" wide x 12"-14" deep.

Allow 18"-20" chair depth for a seated person on a 19" wide chair, an adjustable height one is desirable. Add an additional 20" where passing space is necessary.

Where work stations are used by adults (i.e., community use), provide storage for personal effects.

Rule of thumb: provide 14 - 16 sf. per student, including circulation space.

Adding workstation space and peripherals to a classroom requires adding 14 sf. - 16 sf. of net area per work station to that classroom, all other things being equal.


TYPICAL COMPUTER CLUSTER
PRINTER and/or FILE SERVER
STORAGE for DISKS MANUALS PAPER
MARKER BOARD
TEACHER'S DESK
MOUNTED TV
SCALE
0 ft
5 ft
10 ft
15 ft

A REPRESENTATIVE LAYOUT OF A CLASSROOM WITH CLUSTERED WORK STATIONS

WORK STATION -- Instructional Staff

This is a generic computer work station in any instructional staff se [illegible] recommendations apply for individual settings in groups or singly.

Width : To accommodate a micro computer or computer terminal; [illegible] space for hands, papers, reference materials; input devices [illegible] mouse, light pen, and any necessary peripherals such as a [illegible] telephone. Provide elbow room.

Desktop area : 42" wide x 30" deep for a single person, exluding peripherals; a telephone, modem, external disk drive, and a fax machine, for instance, may require an additional 32" - 46" of width. [3]

Desktop height : Ideally, adjustable from 26" to 29".
Fixed height desktops: provide 26", using a non-adjustable chair or 29" where an adjustable chair will be used.

Recommended position of monitor: 15 degrees down from eye level to the center of the screen.

An adjustable desktop-wide keyboard shelf is desirable. Alternatively, consider providing an adjustable monitor arm.

Storage : Provide paper storage, 1.5 linear feet; books, manuals, disk boxes, etc.; provide drawer for storage of personal belongings.

Furnishings : If stock work stations are considered, allow reference space, storage and adjustable heights as noted above.

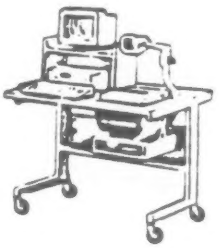
Electrical : Recommendations for work station K - 12 apply.

General : It is recommended that dust covers for computers, including keyboards, and peripherals be used. Provide storage at each work station for personal effects.

Allow 30" depth for a seated person on a 19" wide chair, an adjustable height one is desirable. Add an additional 30" where passing space is necessary.

PORTABLE WORK STATIONS

A simple stainless steel cart with a desk-height work surface and shelf above: 36"w x 24"d x 38"h will serve adequately for a computer.



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[3] For some larger model PCs a desktop depth of 34" may be necessary; consult your vendor.

A portable Microcomputer Overhead Work Center: 48"w x 30"d x 33.5"h. A stainless steel cart capable of holding a computer, overhead projection system and VCR. It is equipped with shelves above and below the work surface.

Laser Disk Player Cart: 37"w x 22"d x 40"h

Portable TV cart: 30"w x 22"d x 48"h

WORK STATION -- Administrative Staff

This is a generic computer work station in any administrative setting. Requirements for the instructional staff work station apply, unless noted otherwise.

Desktop : area	If a computer is to be used on a standard desk, allow a minimum of 16" of desk width. Allow space for a modem, unless one is built into the computer. Allow space for peripherals such as external disk drives (1.2 sf.) and printers (2 sf. for small, 6 sf. for large). See other recommendations under the instructional staff work station above.

WORK STATION -- for the handicapped

The spatial recommendations for the categories of work stations described above apply. Desktop surface clearances must be sufficient for a wheelchair-bound person to move up to a computer keyboard: 25" height to the underside and a 36" clear width for adults. For children in smaller wheelchairs, consult a vendor.

Specialized WORK STATION for a SPEECH THERAPIST:

Portable, self-contained cart, 36"w x 24"d x 38"h for computer, printer and paper tray, and VCR.

PERIPHERALS

It is assumed that all work stations will have the use of one or more of the peripherals listed below. Space must be allocated accordingly.

Printer : Small (80 column) - 2.0 sf.
Wide (132 columns) - 2.6 sf.
Large (laser) - 6.0 sf.
Allow 28" in depth for a printer with a catch basket.

For printers in sound enclosures, allow 6 - 7.5 sf. Sound enclosures for printers are recommended. Exceptions: Laser printers, thermal transfer printers.

Optical scanners, add-on modems, telephone, external disk drives: 0.5 - 1.5 sf. each.

File servers, laser disk players, etc. come in a variety of sizes; allow space equal to one work station.

Master management terminals such as provided by C.C.C., WICAT or others: 25 sf., which includes room for servicing the unit. Provide needed storage above the unit.

Copiers : Allow 9 sf. Consider only heavy-duty copiers. Some manufacturers require an additional 49 sf. of clear area for maintenance.

FAX machines: Provide 8 sf. for the machine, including paper trays, etc.

TWO-WAY INTERACTIVE TV

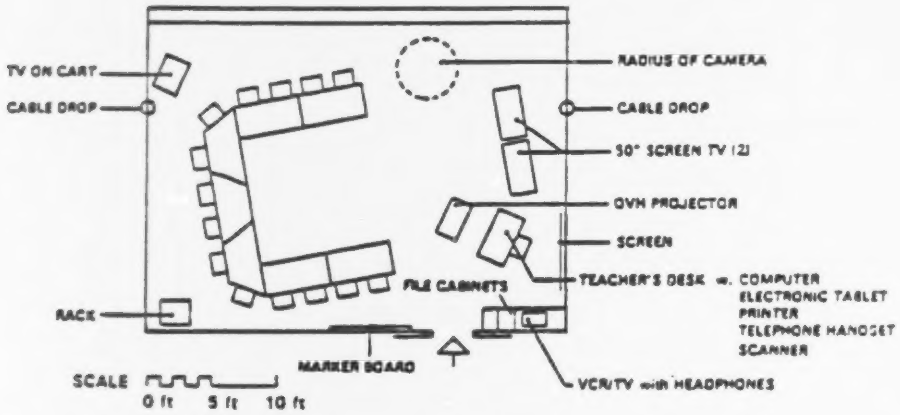
Teacher's desk/work station: 50"w. x 30"d. to house a computer, electronic tablet, scanner, phone and printer. A smaller desktop surface (40"w. x 24"d.) is possible if pullouts for a keyboard (20" x 9") and a LCD display tablet (16" x 16") and shelves for a CPU and printer are provided.

TV monitor carts: 28"w. x 24"d., 32"w. x 22"d.; 50"w. x 33"d., depending on monitor size. Heights are generally 55".
27" monitor: 26"w. x 20"d. x 24"h. (typical).
50" monitor: 48"w. x 28"d. x 53"h. (typical).
Equipment rack: 23"w. x 26"d. x 42"h. (typical).
OVH projector: must be high-powered, ventilated. Provide approximately 3 sf. of surface area.

Projection screen: 72"w. x 60"h., 48" off the floor.
Marker boards: 72"w. x 48"h.

Desk space and file cabinets for program assistant.

Camera: The camera is mounted on a tripod with a base radius of approximately 26". Provide a clear path in the classroom which accommodates both the operator and the camera. A minimum path width of 5 ft. is recommended. Length of path varies according to classroom configuration.


TV ON CART
CABLE DROP
RACK
RADIUS OF CAMERA
CABLE DROP
30" SCREEN TV (2)
OVH PROJECTOR
SCREEN
TEACHER'S DESK w. COMPUTER
ELECTRONIC TABLET
PRINTER
TELEPHONE HANDSET
SCANNER
FILE CABINETS
MARKER BOARD
VCR/TV with HEADPHONES
SCALE
0 ft
5 ft
10 ft

REPRESENTATIVE LAYOUT OF AN INTERACTIVE TV CLASSROOM

SEARCH CATALOGUES -- Library Media Center

Electronic search catalogue console: 30"w. x 35"d.

Check-out space with monitor and printer:
provide 6 sf. plus space for printer.

FOOD SERVICE

Provide 4 sf. maximum at each point of sale at food service counter for computer. Provide 18 sf. at each school manager's location (food service office -two persons) for terminal and printer.

FORMAT FOR EDUCATIONAL SPECIFICATIONS

MARYLAND STATE DEPARTMENT OF EDUCATION
OFFICE OF ADMINISTRATION AND FINANCE - SCHOOL FACILITIES OFFICE

200 WEST BALTIMORE STREET
BALTIMORE, MARYLAND 21201

MARCH 1991

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FORMAT FOR EDUCATIONAL SPECIFICATIONS

INTRODUCTION

The purpose of this document is to suggest to local school systems a framework for the preparation of educational specifications for specific school construction projects. It suggests a uniform and comprehensive format for an edspec document and strives for a consistent edspec preparation process among local school systems. A comprehensive edspec is the complete program necessary for executing an architectural and engineering design for a specific facility. The intent of this guide is to aid those charged with the planning of school facilites in the drafting of a superior edspec for such a facility.

When completed, a comprehensive edspec will also serve as a document of record for the completed facility. At any time in the future, such as during alterations or renovation, it may be referred to for past reasons that shaped the form, systems, and contents of spaces; information that may otherwise be lost. Because rapid developments in teaching and technology necessitate frequent change, a well-executed edspec, by preserving past reasons, will make the "why" of the physical forms and spaces more apparent.

The Model Educational Specifications for Technology in Schools [1], a document which addresses electronic technology in school facilities, is designed to the same format as this guide. It is recommended that persons involved in the execution of an educational specifications document use both documents and do so for each specific school to be built, added to, or renovated.

This Format for Educational Specifications conforms with Appendix D in the Public School Construction Program Administrative Procedures Guide [2]. It was revised and developed into its present form by the Technology in Maryland Schools (TIMS) committee under the chairmanship of J William Ilmanen, Maryland State Department of Education.

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[1] A publication from the School F[illegible], Maryland State Department of Education.

[2] Board of Public Works, State of Maryland

THE DESIGN PROCESS

A building design process is program-driven and founded on some set of beliefs. A host of progressively more specific requirements are resolved into a physical product. The program is the edspec and so is a general statement of beliefs such as those under Section I below. Precise requirements and recommendations for each activity that must occur in the building evolve from here. The expectation is that the beliefs will be expressed in the building's form and character.

The design process for a school building does not begin with drawings of plans but with the formulation of a program called the educational specifications, edspec for short. The edspec must convey all objectives to the design team in clear and unambiguous language. The components of Section II deal with the objectives. Sections III, IV and V deal with the spaces and activity areas, particularly with overall and specific features to be provided in each.

Basing their approach on the edspec's program requirements, the building design team seeks to find the optimal a design solution through repeated feedback from edspec committee members and through refinement of the plans.

The physical interpretation of intangible program requirements is at the heart of the architectural design process. As such, nothing in this guide is intended to be prescriptive or restrictive. It serves to provoke thoughtful consideration of needs and requirements. The intent is that such consideration will encourage innovation and vision that confirm the edspec program requirements in a succesful building design solution.

Using computer-assisted design (CAD) throughout the design process is rapidly becoming standard practice in architectural design. CAD has definite design management advantages and should provide long-term benefits for the school and the local school system.

The edspes development process varies among educational agencies as does the composition of the groups charged with producing them. Those charged with producing educational specifications should have as their goal a school facility that meets all stated objectives, enhanced by the architects' professional skill.

In the final analysis it is the educators, not the architects, who are charged with the responsibility for managing instruction. Since it stands to reason that facilities have the power to foster learning and influence teacher behavior, educators must not delegate critical program decisions to architects. However, the responsibility for shaping those decisions rests with the architects.

Those charged with the preparation of an edspec must, therefore

- Establish and define curriculum needs, student characteristics, instructional plans, and the uses of electronic technology.
- Base adjacencies and physical relationships of activity areas on the above.
- Decide on the spatial requirements for all areas. They are determined by instructional requirements, student characteristics, electronic technology and furnishings.

THE REVIEW PROCESS

The development of a facility design through its completion requires compliance with local and national building codes, life safety codes, health codes, and handicapped access codes. Consult with the local fire marshal for interpretations of local and state fire prevention code requirements. Architects, engineers, and select local education agency staff are advised to be knowledgeable of various codes to the degree of their respective responsibilities.

There should be a designated repository in the education agency's offices for educational specifications and construction contract documents, including [illegible] ones and electronic technology systems documents. Also, every school should [illegible] a set of the same documents for their school. They provide immediate access [illegible] and construction data not otherwise readily available. These documents should [illegible] in the principal's office.

The educational specifications document should be organized in a sequential manner that is logical and user-friendly. Below are suggested contents for a title page and the organization of chapters under a table of contents.

TITLE PAGE

- Name of the school or, if a generic edspec, the type of school (e.g., elementary)
- Name of the local education agency
- List of local board of education members, if desired
- List of members of the educational specifications committee, including ex-officio members and consultants, if any
- Date

TABLE OF CONTENTS

SECTION I PROJECT RATIONALE

Introduction
The Community
School Board Policies
Belief Statements
Scope of Work, Budget, and Schedule

SECTION II EDUCATIONAL PLAN

Curriculum Component
Instructional Method Component
Staff Support Component
Technology Component

SECTION III PROJECT DESIGN FACTORS

Site Conditions
Building Systems

SECTION IV ACTIVITY AREAS

General Overview
Program/Service Function

SECTION V SUMMARY OF AREA RELATIONSHIPS

SECTION VI SUMMARY OF SPACE REQUIREMENTS

SECTION I – PROJECT RATIONALE

INTRODUCTION

A comprehensive educational specifications is the complete program necessary for executing an architectural and engineering design for a specific facility.

An edspec serves as a document of record for this facility at the time of future construction and renovation; the edspec is the repository of the reasons that shaped the form, systems and contents of spaces.

- The Introduction should contain a project justification and description.
- It should also state certain general objectives such as:

  To promote student and staff well being
  To promote learning and study
  To promote administrative efficiency and ease of maintenance
  To create an attractive facility, properly oriented on its site
  To make a positive statement for the community
  To be technologically current
  To be energy efficient

THE COMMUNITY

Provide a brief description of the community today, its recent past, and the forces shaping it. Project the future for the next 5 to 10 years.

Provide a map of the community and surrounding area, indicating the school location and the school attendance area.

SCHOOL BOARD POLICIES

Provide a brief statement on local school board policies that have a direct impact on facilities such as (in alphabetical order):

After-school use of certain facilities
  including playing fields
Curriculum offerings
Special programs
Staffing ratios
Standard school enrollment size

BELIEF STATEMENTS

Belief statements encapsulate and convey concepts and philosophies that are fundamental to the design and character of a particular school. The following beliefs are presented to serve as a guide to local education agencies and every person involved in the execution of each edspec:

- Every school facility will contribute constructively to its occupants' educational, physical, and emotional needs and sense of well-being when physically designed to do so.
- Every school facility will serve as a teaching tool when physically designed to do so.
- Learners should be stimulated by the school facilities they inhabit throughout their years of schooling.

- Every school facility is a community resource; it serves and takes advantage of the community's resources, both human and technological.
- Judicious use of advanced building engineering systems enhances facilities operations and maintenance.
- The Educational Delivery System must include physical environments that effectively utilize changing technologies.
- School facility design must avoid being state-of-the-art specific. It must be capable of adjusting to future technological demands.

Educational facilities convey subtle messages, they aid or inhibit performance or they influence programs and the way they are offered.

SCOPE OF WORK, BUDGET AND SCHEDULE

Provide enrollments (head count and full-time equivalent) for the current year (September 30) and projections for each of the following five years.

Provide a brief description of the scope of the work, including areas to be renovated. Include the gross square footage for proposed new construction and, when appropriate, the gross square footage (by the age of structures) for proposed alterations and renovations. If future expansion of facilities is anticipated, indicate how this will be addressed in the current project.

If state funds for the project will be applied for or have been approved, provide the gross square footage that is eligible for state funding. Provide also the proposed net square footage.

Provide the anticipated project costs for construction, site work, and a contingency for change orers. Specify the anticipated sources of funding.

Develop a project schedule. The schedule should show the the expected initiation and completion of the following phases:

Educational specifications
Schematic design
Design development documents
Construction documents
Construction (including any separate contracts)
Owner's date of occupancy

SECTION II – EDUCATIONAL PLANS

CURRICULUM COMPONENT

Describe the specific teaching objectives and learning outcomes characterizing the school's instructional program.

> Comment: While all schools conform to the systemwide curriculum component, there are unique requirements for each building depending upon its instructional focus. For example, will the school concentrate more heavily on vocational offerings or be more academically oriented? Is there to be a greater emphasis upon technology in this school than in the average building? Is this to be a magnet school with unique programs requiring unusual classroom configurations? Does this school serve an unusual population -such as special education or non-English speaking students- for whom special classroom arrangements are necessary?

Describe the broad facility needs generated by the instructional program.

> Comment: While there are the "standard" physical needs generated by the school system's curriculum, there are also the unique requirements of that school's unique program. These would include such things as smaller classrooms for small group instruction. special technical requirements for instructional equipment or technological innovations such as interactive television or computer networks, team teaching rooms, shops, etc.

Describe the current or projected needs to serve such programs as adult education, day care, before-and-after-school programs (i.e., latchkey children), and community education.

INSTRUCTIONAL METHOD COMPONENT

Describe the major instructional methods planned for the school.

Comment: Any physical and environmental requirements demanded by the plan are to be recorded here. Additionally, utilization of such methods as large group instruction, small seminars, individual study areas, computer-assisted instruction, cross-activity area activities, inter- and intramural needs, and shared facilities by multiple activity areas should be explicated here.

STAFF SUPPORT COMPONENT

Describe briefly the school's staffing organization; include:

Instructional (including aides)
administrative
operational
other

Provide a list of the number of persons under each category; include part-time personnel.

TECHNOLOGY COMPONENT

Describe how electronic systems are to be integrated with educational plans and facilities. Please refer to the document Model Educational Specifications for Technology in Schools.

SECTION III – PROJECT DESIGN FACTORS

SITE CONDITIONS

Identify which utilities (sewer, water, electricity, gas, etc.) are, or will be, available. Identify those provided by public utilities and those provided on site.

State the requirements for separation of school bus and automobile traffic, student pick-up and drop off.

State the number of staff, visitor, and handicapped parking spaces required. State any applicable local school board and local government requirements

State the requirements for playing fields and courts; i.e., type and size, location and accessibility (including handicapped access).

Identify any unique site conditions (i.e., traffic noise, wind or special features.

BUILDING SYSTEMS

Included herein are broad and general descriptions of the building systems and infrastructure (existing or proposed), and their desired performance. Requirements that are not specific to discrete activity areas should be covered in this section. It is the collective requirements for the activity areas that determine the engineering of each system. The first eight building systems and components listed below are featured in the Model Educational Specifications for Technology in Schools under Section II - Building Components.

STRUCTURAL: Identify needs for flexible interior space and requirements for future additions or reductions in the size of the school. Identify those system needs that impact on the design of structural systems.

ELECTRICAL POWER: Identify electrical power needs including the condition of power for computers, emergency power, backup systems, and grounding requirements.

LIGHTING: Identify exterior requirements for lighting. Identify various interior requirements for lighting. Identify the needs for direct daylight at eye level and any needs for indirect or clerestory-level daylight.

CLIMATE CONTROL: Identify the needs for heating, ventilation, and airconditioning. Indicate which programs or services and which portions of the building require special climate control. Consideration should be given to indoor air quality and energy conservation.

FIRE/LIFE SAFETY: Describe the desired performance of a desired fire/life safety system. Identify the applicable building and life/safety codes.

SECURITY: Identify the interior and exterior security requirements; special attention should be given to the security of expensive and sensitive equipment, and records storage. Develop a security plan, including access control, for the school.

ACOUSTICS: Identify any uncontrollable exterior noise (i.e., low-flying aircraft, heavy traffic). Systems-generated noise (i.e., HVAC fans and motors, air turbulence in ducts) must be controlled. For permissible noise exposures in activity areas that may generate noise (i.e., some career and technology education labs), consult the Code of Federal Regulations, Title 29, Part 1910.95, Occupational noise exposure, latest revision.

BUILDING SUPPORT: Support spaces included under this category are mechanical and electrical spaces, equipment repair areas, wiring and conduits, and distribution spaces.

ELECTRONICS: Identify the performance needs of communications systems (i.e., telephone, public address, energy management, etc.).

PLUMBING/GAS: Identify the needs for water, gas, and waste removal.

PUBLIC ACCESS: Identify the areas designated for public use during other than normal school hours. Identify restrooms accessible to the public.

HANDICAPPED ACCESS: Identify the school site and the building access requirements for handicapped students, school staff, and other adults.

SECTION IV – ACTIVITY AREAS

GENERAL OVERVIEW

Unless covered under Section I or Section III, the following should be addressed in this section:

- If future expansion of the facility is a design consideration, state which areas or core facilities (cafeteria, library media center, administration, etc.) will be affected.
- When plug-in classrooms are a design consideration, state any specific design criteria which must be met due to existing conditions or other reasons.
- Describe any design criteria which must be met due to existing or other conditions.
- Determine the desired way for switching banks of classroom lighting. Determine the areas and fixtures to remain lighted when the building is unoccupied.

ACTIVITY AREAS

Activity areas are the core of educational specifications. They include all discrete spaces in the school building. Activity areas related by teaching objectives and learning outcomes are grouped together under a single heading. Some activity areas may serve more than one function. Determine the most likely main function of the area, then place it under the heading most appropriate.

Examples: A music classroom's main function determines it to be located under instruction.

A computer lab may be instruction-specific (for math, for example) or interdepartmental (for general use). The supervising entity should determine the most appropriate group heading.

A description of each educational program and service function should be provided.

Instructional support consists of specialized instructional areas used by more than one curriculum.

Example: A computer lab used by math as well as social studies.

Suggested headings for activity area groupings, common to most elementary and secondary schools, are as follows:

Administration	Health
Building Support	Instruction
Food Service	Instructional Support
Guidance	Library Media Center

Under Instruction are located sub-headings such as Career and Technology Education, Art, Music, Physical Education, Science, Special Education, and others. Under Building support are located such spaces as mechanical and boiler rooms, work rooms, equipment repair areas, distribution spaces, janitors closets, toilet facilities for building-wide use, etc. Because of increasingly sophisticated building systems, these areas should be part of a comprehensive edspec.

Identify each support space such as a science prep area, unisex toilet in a kindergarten classroom, storage room, etc., as a separate activity area. Describe its relationship to relevant activity areas. Specify how it will function, applicable security requirements, what the requirements are, i.e., what is to be stored, an approximate quantity, and in what manner.

PROGRAM AND SERVICE FUNCTIONS

Each activity area specification should be written in accordance with the following format:

ANTICIPATED USES: Identify the planned experiences and activities. Verbs describing specific actions (paint, read, write, etc.) are more acceptable than general descriptions (work, study, interact, etc.).

NUMBER OF USERS: State the number of students, teachers, adults, [illegible] who will use the space.

GROUPINGS: Identify anticipated group sizes and state if the following [illegible] be accommodated: large or small group instruction, individual student [illegible] team organization.

RELATIONSHIP to or isolation from other activities: Identify the relationship of this activity area to others inside (and outside) the building. Identify the direct (essential), indirect and convenient adjacencies.

SPACE REQUIRED: Describe the capacity of space that is needed to accommodate changes in groupings. State any need for subdividing or combining the activity area with an adjacent one, and the frequency of such adjustment. State the number of net square feet of floor area required.

SUPPORT SPACES: Identify those activity areas necessary for the support of the educational program in this activity area. Examples of such areas: Student projects, science prep, teacher planning, seminars, shared storage, etc.

For the purposes of this section, portions of certain building systems within each activity area must be described and located in sufficient detail to insure that various requirements are met. The requirements are based on the needs of the curriculum components and the instructional method components and the needs for human comfort.

The systems requirements for the collective activity areas, support spaces and circulation areas determine the engineering of each building system. Broad and general descriptions of the building systems and infrastructure are described under Section III - Project Design Factors; they should not be repeated here. Describe only requirements **unique to each activity area** in accordance with the following examples:

STRUCTURAL: Spans between supports, floor-to-ceiling heights, under-floor conduits, unique wall conditions, etc.

ELECTRICAL POWER: Dedicated circuits and outlets; special outlet and switch locations, etc.

LIGHTING: Daylight requirements, special fixtures, layouts, etc.

CLIMATE CONTROL: Avoid undesirable locations of fresh air supply, exhaust; special ventilation requirements, locations for controls, etc.

FIRE/LIFE SAFETY SYSTEMS: Locate, where space and occupancy needs dictate, sensors, monitors, alarms, etc.

SECURITY: Use of the activity area during non-school hours; special security requirements for doors, windows, site surveillance, etc.

ACOUSTICS: Special requirements for noise containment, sound abatement, sound projection, etc.

ELECTRONICS: Placement of equipment and TV locations, shielding, etc.

PLUMBING/GAS: Kind, size and type of fixtures, special traps, drains, etc.

PUBLIC ACCESS: When appropriate, state the number anticipated days per week, weekends, hours, frequency, number of persons, etc.

HANDICAPPED ACCESS: Door openings, fixture and countertop heights, elevator cabs, etc.

FINISHES: Conditions requiring special finishes on walls, ceilings and floors.

STORAGE: Identify what is to be stored. Specify storage requirements, shelving, and lockers in meaningful terms (i.e linear feet, sq.ft. of floor area, height requirements), the requirements for fixed and adjustable shelving, locked storage, etc.

DISPLAY: Identify display requirements, types of display (i.e., casework, tack and markerboards, screens, etc.), and location. State the required quantity in meaningful terms (i.e., linear feet, height and width, etc.).

FURNITURE AND EQUIPMENT: Two categories - fixed, which is built-in and usually a part of the construction contract, and movable, which is brought in and put in place by the local school system. State required quantities in meaningful terms (i.e., special drawers, number of shelves, linear feet of casework, number of pieces, etc.).

SECTION V – SUMMARY OF AREA RELATIONSHIPS

Summarize the relationships between activity areas in a matrix or diagram. It also may be desirable to show some internal relationships within complex activity areas.

SECTION VI – SUMMARY OF SPACE REQUIREMENTS

The summary of space requirements is a list of all net square footages of each activity area, as programmed above, plus a percentage of the sum of net square feet allotted to circulation, mechanical space, toilet areas, etc., not included as activity areas, and wall thicknesses, etc., for a total number of gross square feet of the entire facility.

THE COMPLETED DOCUMENT

An educational specifications document, to be consistent with its purpose, would be written in terse, precise language. Its format should facilitate scanning and quick information retrieval. Essay-like descriptive writing should be employed only sparingly. Such writing does not lend itself well to a format which benefits from compacting all information on the fewest pages possible.

ACKNOWLEDGEMENTS

The forming of the Technology in Maryland Schools committee (TIMS) was approved by the The Maryland State Department of Education, Office of Administration and Finance. School Facilities Office. The past and present members of the committee are:

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